CITY UNIVERSITY OF LONDON

Robots in the Library: gauging attitudes towards developments in robotics and AI, and the potential implications for library services

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Abstract

This dissertation consists of an in-depth literature review, and the results of original research. The aim was to explore the impacts of automation of human work, with a particular focus on recent advances in robotics and AI and how these may affect library services and library work in future. Key issues explored in the literature review include: reasons why AI and robotics are advancing so quickly, which jobs are more likely to be automated than others, public perceptions of robots and AI, existing examples of automation in libraries, and predictions for the future of library work. The original research consisted of a survey of the general population, including library users and workers, and a focus group with library workers only. Key themes explored include: general perceptions and experience of automation in libraries, potential acceptance levels of robots being used in libraries, and the predicted positive and negative outcomes.

The findings of the research, supported by the literature, indicate a general consensus that automation is perceived as positive where it releases humans from doing mundane or undesirable work. However, there are also genuine concerns that job losses may occur, and that there will not be enough new jobs to replace them. There is also a recurrent idea that robots and AI cannot, and may never be able to, offer the crucial 'human touch' and empathy that many people see as a necessary feature of many types of work; points that are certainly relevant in relation to libraries and library work. When considering library work more specifically, issues arose around the feasibility of new technologies in a library environment. There is a perception that much of the complex enquiry work done by library workers is not yet automatable, and should arguably remain in human hands.

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Research Aims and Objectives

Aims:

This project aims to investigate the likely impact on human employment by AI/robotics, with a specific focus on library workers and users of library services.

Objectives:

- To analyse existing literature and research into peoples' perceptions of AI/robotics and how this could be relevant for libraries.
- To explore existing examples of automation in libraries, and the impact this has had so far.
- To gauge perceptions of AI/robots in a Library context and establish which areas of library services users/workers may be more comfortable 'handing over' to AI/robots.

1. Introduction

In the 2012 film 'Robot and Frank' a near-future is depicted where robots have entered into everyday life, being employed as personal carers for older people, and working in other roles once carried out exclusively by humans. One prominent example introduced is a 'book-stacking robot' called Mr. Darcy, who greets patrons as they enter the library. Robots have been a popular feature of Science Fiction for decades, with the term 'robot' first being used in the 1920s (Winfield, 2012). Many would now argue that the kinds of advanced robots and Artificial Intelligences (AI) depicted in these stories are becoming increasingly feasible in the real world, and that recent developments have converged to make it more and more likely that a growing number of human jobs will have the potential to be automated. Automation is of course not a new phenomenon, and history has shown that when new technology disrupts human employment this is accompanied by waves of fear and apprehension, going back to the industrial revolution and continuing with the computerisation of the twentieth century (Frey & Osborne, 2013; Ford, 2015).

Widely agreed in recent years is the idea that we have now reached a point where the kinds of jobs that can potentially be carried out by machines are rapidly expanding beyond the routine mechanical work that has been carried out by industrial robots for decades, and into more non-routine tasks, and the 'white collar' areas of knowledge work (Kaplan, 2015; Bollegala, 2016; Willcocks, 2016). A range of technological advances have converged, including increased computing power, higher capacities of memory for big data, cloud computing, and advances in robotics technology, which means that the potential capabilities of AI and robotics have been greatly expanded (Pratt, 2015). Some areas where we can already see demonstrable progress include the recent victory of AlphaGo, driverless cars, robotic surgery, and autonomous drones (McAfee & Brynjolfsson, 2016; Xerox, 2016).

With these advances comes a huge responsibility for humanity. The polarised sides of the debate would argue that we are either heading towards the 'singularity', whereby AI will reach the point where it overtakes humans and could potentially destroy humanity, or that the capabilities of AI have been massively exaggerated and that we have nothing to fear. The truth, as is often the case, probably lies somewhere in the middle, as argued by figures such as Kaplan (2015) and Floridi (2016). Although we may arguably never create a truly 'intelligent' machine with a sentience comparable to humans, we are undeniably achieving more and more impressive results. This looks set to continue, with some level of automation eventually becoming a possibility in virtually all areas of human work, as shall be discussed.

A utopian vision for the future, such as the one presented by Srnicek and Williams (2015), presents the idea that automation can hugely benefit human workers and should be encouraged, removing the need for humans to do dull, dirty, and dangerous work. This has already been demonstrated to some extent, with robots being used for search and rescue operations, mining, bomb disposal, and advanced algorithms carrying out data analysis in seconds that would take a human many tedious hours. The flipside of this is that as a greater range of work can increasingly be carried out more safely, efficiently, and effectively by smart machines, the human workers may simply be replaced, and there may not be enough new jobs for them to move into. With our current economic and political systems this could arguably lead to devastating levels of unemployment, and an increasing wealth gap between the business owners and technology developers who would benefit from automation, and the workers who would be replaced. As will be discussed, there are a range of potential solutions for these issues that are being debated, and various interpretations of the impacts that automation will have.

As shall be demonstrated, issues around the future of automation can be seen as extremely relevant to library workers and users. Libraries have already gone through huge shifts in the ways they operate due to advances in technology, with computerisation in the 20th century, followed by the rise of the internet and digital information, and accompanied by a move towards increasingly automated physical processes allowed by RFID and self-service (Palmer, 2009; Lewis, 2016). Library workers have perhaps gone from being seen as custodians of knowledge, to a more outward facing role, as information has become increasingly free and available outside the constraints of the physical library building. Print collections, which have traditionally required much human labour to maintain and provide access to, are still extremely important and widely used, but as the capabilities of robots advance this kind of work could potentially be increasingly removed from human library staff. In terms of digital information, the implications of advances in AI are perhaps even more significant for the future of library work. Advanced tools for searching and analysis are being combined with natural language processing to create increasingly powerful services, that could potentially handle complex enquiries as accurately as a human library worker.

Although making predictions on the future of any profession is very difficult, this study will attempt to do so through a combination of examining the existing literature, and original research. While there has been much commentary and academic research into the potential future impacts of automation, and attempts to gauge public reactions to this, there has not yet been a study focused specifically on library staff and users' perceptions of robotics and AI. The original research carried out for this dissertation has therefore attempted to do this, using the mixed approach of an online survey and a focus group, and building on some of the related research that has already been carried out. It is hoped that this original research, combined with an analysis of the literature and previous studies, will be able to draw out some interesting issues related to libraries and automation, reflecting on the past, evaluating the present situation, and looking ahead to what the future may hold for libraries, and library workers in particular.

2. Literature Review

2.1. General background to automation, robotics and AI, and public perceptions

2.1.1. Brief history of automation, robots and AI

Bollegala (2016) points out that: 'Since the industrial revolution, roles that were once exclusively performed by humans have been slowly but steadily replaced by some form of automated machinery.' Thus, automation of work is by no means a new phenomenon, and the subject has always been controversial, perhaps epitomised by ongoing references to the 'Luddite' riots of the early nineteenth century, where a group of English textile workers destroyed machines that they feared were deskilling their trade, leading to severe repercussions from the government (Frey & Osborne, 2013, 7).

The concept of 'deskilling' is identified as a key factor when considering the impact of technology on human labour, by Frey & Osborne (2013, 10):

> An important feature of nineteenth century manufacturing technologies is that they were largely "deskilling" – i.e. they substituted for skills through the simplification of tasks. The deskilling process occurred as the factory system began to displace the artisan shop, and it picked up pace as production increasingly mechanized with the adoption of steam power. Work that had previously been performed by artisans was now decomposed into smaller, highly specialised, sequences, requiring less skill, but more workers, to perform.

Interestingly it can be seen that early examples of automation were not necessarily synonymous with fewer jobs for people. However, Frey & Osborne (2013) go on to point out that there was a reversal of this with the rise of electrification in the twentieth century, which allowed many parts of the production process to be automated, requiring a higher level of skill in workers to operate the new machinery, but fewer of them.

One view is that advances in technology in the twentieth century have driven us towards a more prosperous society in the developed world, and that automation and globalisation may have led to less jobs in the manufacturing sector, but these have been replaced with new service jobs (Ford, 2015). This transition has not been simple however, as was seen with the 'Triple Revolution' of the 1960s, described by Ford (2015, 31): 'The specter of mass joblessness as machines displaced workers had incited fear many times in the past - going all the way back to Britain's Luddite uprising in 1812 - but in the 1950s and '60s, the concern was especially acute and was articulated by some of the United States' most prominent and intellectually capable individuals.' Ford (2015) goes on to argue that these fears were actually unfounded if we consider the economic evidence of the time around employment, but the important thing is that the fears were certainly present.

Frey & Osborne (2013) single out the Computer Revolution as a key driver of twentieth century automation, starting with the first commercial uses of computers around 1960, and continuing with the development of the Internet and e-commerce in the 1990s. They link the declining cost of computation, by an average of 37 percent per year between 1945 and 1980, with the mass redundancy of telephone operators, the first industrial robot being used at General Motors in the 1960s, and airline reservations systems taking the first steps into self-service technology in the 1970s (Frey & Osborne, 2013, 11).

Robots have now existed and worked alongside humans for many years, with Winfield (2012, 20) describing them as 'the workhorses of robotics: the unglamorous robots that have been busy in

factories for decades.' The concept of some kind of mechanical human that can help us with our work has existed in the minds of different cultures throughout history, physically manifesting itself in the form of early automata, but the term 'robot' was only first used in 1920, in Karel Čapek's play *RUR (Rossum's Universal Robots)* (Winfield, 2012, xii). The long-established industrial robots of the second-half of the twentieth century have been predominantly non-human in their form, but Winfield argues that even now '…our expectations of what robots are, or should be, draw much more on fiction than on reality,' meaning for many people the term is synonymous with an 'intelligent mechanical person' (2012, xii). This idea of anthropomorphism is seen as problematic by figures such as Kaplan (2015), as it has arguably led to misconceptions in the general public about what robots are capable of.

Alongside developments in computing and robotics were emerging theories around the potential of AI. Winfield defines AI as 'the science and engineering of intelligent machines, including computers,' with robotics defined as the branch 'concerned with physically embodied AI' (2012, 133). As shall be discussed, there is much ongoing debate about the level of 'intelligence' actually displayed in existing forms of AI, and indeed how we can define 'intelligence' at all. Floridi (2016) points out that fears around AI date right back to the beginning of discussions around intelligent machines linked to father of AI Alan Turing, with his colleague John Good's observation in the 1960s that: '…the first ultra-intelligent machine is the last invention that man need ever make, provided that the machine is docile enough to tell us how to keep it under control.' Floridi (2016) is personally cynical about the potential for genuinely 'intelligent' machines to be created, but the important point here is that debates around the potential for AI to be harmful to humans have already been taking place for decades.

In terms of our current situation it is clear that computerisation and the internet, as well as the use of existing robots, have already greatly impacted on human work. Winfield (2012, 41) reports that at the time of him writing there were estimated to be over eight million robots currently in use worldwide, and that: 'The range of real-world robots and the jobs they do is extremely broad, and illustrates that there are few areas of human endeavour that have not, to some extent, already benefited from robotics technology.' However, he also observes that '...few real-world robots are able to learn or adapt their behaviours,' suggesting that the majority of the robots in use were of a relatively simple nature, with the argument that machine learning was a big challenge for researchers and that robots that can learn '…pose a particular problem when it comes to certifying the safety of a robot' (Winfield, 2012, 58). Although Winfield was only writing four years ago, it can be argued that there have since been several key developments in the fields of machine learning but that the potential ethical issues around safety of course remain, as shall be discussed.

2.1.2. Why is now different? – recent developments in robotics and AI

Although robots and AI have been under development for many decades now, there seems to be a growing consensus that we are on the edge, or indeed already tipping into, a new era of development, with Pratt (2015, 52) pointing out that: 'Commercial investment in autonomy and robotics—including and especially in autonomous cars—has significantly accelerated, with high-profile firms like Amazon, Apple, Google, and Uber, as well as all the automotive companies, announcing significant projects in this area'. Since the early years of robotics and AI in the twentieth century, technology has improved at an exponential rate, and we have arguably now reached the point where 'the promises of science fiction are quickly becoming workaday realities' (McAfee & Brynjolfsson, 2016).

Pratt (2015, 53) lists the eight key technological changes he believes could be leading to a tipping point, which he argues will allow the new areas of 'Cloud Robotics' and 'Deep Learning' to thrive:

1. Exponential growth in computing performance
2. Improvements in electromechanical design tools and numerically controlled manufacturing tools
3. Improvements in electrical energy storage
4. Improvements in electronics power efficiency
5. Exponential expansion of the availability and performance of local wireless digital communications
6. Exponential growth in the scale and performance of the Internet
7. Exponential growth of worldwide data storage
8. Exponential growth in global computation power

This is supported by Willcocks (2016, 40), who lists several key technologies such as microcontrollers, machine vision, motion sensors, image and voice recognition software, and component miniaturisation as having reached 'critical mass in terms of processing speed, connectivity, efficiency and cost effectiveness.' He argues that this has '…dramatically increased the number of functions, and industries, that can be effectively served by robotics and automation.'

As technology related to robotics and AI has improved, the related costs have gone down, leading to greater numbers of robots being purchased, with the University of Sheffield (2016) reporting that industrial robot sales had risen to US$35 billion in 2014 and were predicted to nearly double by 2018. Crucially they also write that '…more surprising is the upsurge in service robots for everything from healthcare to the care of children and the elderly, from cooking and preparing food to making and serving cocktails, from domestic cleaning to agriculture and farming, from policing, security and killing in armed conflict to monitoring climate change and protecting endangered species' (University of Sheffield, 2016). If this trend continues it would support Winfield's (2012, xii) prediction that '…by 2020 many households will have one or more robots, perhaps a driverless car, several cleaning robots, and an educational or entertainment robot.'

The undeniable advances and increase in usage of robots and smart technologies, have led to grand claims such as this one by Bollegala (2016): '…we now live in an era dominated by artificial intelligence…a collection of technologies that can be used to imitate or even to outperform tasks performed by humans using machines.' Advances in AI have certainly produced incredible results, and now mean that tasks once seen as impossible to automate are now well within the realm of computers' capabilities. McAfee & Brynjolfsson (2016) provide examples such as machines that can drive themselves in traffic, write prose, generate scientific hypotheses, compose music and beat humans at games such as chess and go.

However, there is an ongoing debate around the meaning of 'Intelligence' in the context of AI, as described by Handman (2016):

> The real turning point will be if, or when (and it increasingly seems like a question of when), machines become genuinely creative. We have long been able to automate physical tasks, but automating cognitive tasks is a much more difficult hurdle. Researchers, argue the definition of artificial intelligence and whether it has been achieved, but everyone agrees that we aren't quite there in terms of a true general intelligence. They also agree we're getting close.

This question around the differences between automating physical work and cognitive work, and routine and non-routine tasks, is a key one.

Commentators such as Kaplan (2015, 198) have focused on the semantics of AI, going back to the famous 'Turing Test': '…Turing wasn't trying to establish a test that machines must pass to join the ranks of the intelligent; he was speculating that by the end of the century the meaning of words like *thinking* and *intelligence* would shift to include any machine that might pass his test, just as the meaning of the word *music* has shifted to accommodate the output of machines that can reproduce the sounds a musician makes.' He uses the example of Siri to show that we may use language such as 'intelligent assistant' with such technologies, but this does not mean we consider them to have anything resembling a human brain (Kaplan, 2015).

Floridi (2014, 143) follows a similar school of thought, with his argument that 'ICTs are not becoming more intelligent while making us increasingly stupid,' but that the world is becoming an 'infosphere' that is increasingly adapted to enable machines to operate within it. He draws a distinction between 'productive' AI and 'reproductive' AI, with an argument that it is the latter that produces the best results: '…AI should not try to *simulate* human intelligent behaviour. This is the glass wall we should stop hitting. AI should try to *emulate* its results…' (Floridi, 2014, 140). In a recent article Floridi (2016) even goes so far as to say: 'True AI is not logically impossible, but it is utterly implausible.' Whether people believe that true general intelligence is possible for machines or not, there is a consensus that automation is no longer limited to routine tasks, and this undoubtedly has significant implications for the future of human employment.

2.1.3. Predicted impacts on employment

The technological advances previously discussed have led to much commentary about a coming wave of automation, and many attempts to predict which kinds of jobs are most likely to be affected. One clear example where jobs have been increasingly automated is the industrial sector, which employed 1,000 robots in 1970 and today uses over 1.6 million; as a consequence, fewer people now working in factories (Srnicek & Williams, 2015, 110). More recently, there is also evidence that the service industries are being affected by 'roboticisation', with over 150,000 professional service robots sold in the past fifteen years (Srnicek & Williams, 2015, 110). Although not yet on the scale of industrial robots, service robots are clearly on the rise, and they do not necessarily need to take a physical form but can also act within a piece of computer software in the form of Robotic Process Automation (RPA), as described by Willcocks (2016).

Srnicek & Williams (2015, 110) argue that 'routine' manual and cognitive jobs have been most affected over the past four decades with the rise of computerisation and robotics, but that 'non-routine' jobs are now also increasingly at threat. Ford (2015, 61) supports that idea with the following prediction:

> As the technological frontier advances, many jobs that we would today consider non-routine, and therefore protected from automation, will eventually be pulled into the routine and predictable category. The hollowed-out middle of the already polarized job market is likely to expand as robots and self-service technologies eat away at low-wage jobs, while increasingly intelligent algorithms threaten higher-skill occupations.

A similar observation is made by Frey & Osborne (2013, 44), who point out that algorithms for big data '…can readily substitute for labour in a wide range of non-routine cognitive tasks,' and that '…advanced robots are gaining enhanced senses and dexterity, allowing them to perform a broader scope of manual tasks.' Kaplan (2015, 134) predicts that not only will new technologies 'substitute directly for workers,' but they will also '…eliminate the types of jobs they perform' as the environment they work in changes to a point where humans can no longer operate in it, perhaps linked to Floridi's (2014) concept of the 'infosphere'. He sums up these views with the memorable phrase that 'automation is blind to the color of your collar' (Kaplan, 2015, 145).

While there are those who argue that no job is completely safe from automation, there is still an acknowledgement that certain skills will remain very difficult to automate for the foreseeable future, and therefore the jobs that require those kinds of skills may be 'safe' for the time being. Willcocks (2016, 254) predicts that in future there will be '…a higher focus on the value of human workers who can deliver results in jobs requiring creative thinking and subjective decision-making. 'Frey & Osborne (2013, 27) support this with their argument that even though many non-routine tasks can now be automated, '…occupations that involve complex perception and manipulation tasks, creative intelligence tasks, and social intelligence tasks are unlikely to be substituted by computer capital over the next decade or two,' which shall be explored further below.

As well as the more general commentaries on which jobs are likely to be automated, there have also been several attempts to provide specific predictions on exactly how many jobs will go, the likelihood for particular fields to be affected, and the timeframes involved. Srnicek & Williams (2015, 112) concentrate on the percentage of jobs that could potentially be automated already, citing estimates that between 47 and 80 per cent of current jobs are susceptible. Handman (2016) lists several examples where the time frame, as well as the percentages, are predicted: 'Boston Consulting Group predicts that by 2025, up to a quarter of jobs will be replaced by either smart software or robots. Gartner, a technology research firm, ramps that estimate up and predicts that one third of all jobs will be eliminated by 2025, while University of Oxford researchers Carl Benedikt Frey and Michael Osborne say a grand total of 47 percent of US jobs will be automated by 2033.' Perhaps the most famous paper on this subject is the one put together by Frey and Osborne (2013), which is frequently cited in discussions of automation, (for example by Das (2016), Bowden (2016), and Bollegala (2016)) so we shall now examine this in more depth.

In the original paper Frey & Osborne (2013) explain their motivation for the research: there had not yet been a study to quantify 'what recent technological progress is likely to mean for the future of employment'. They intended to bridge that gap. Referring to technological developments related to robotics and AI, they describe their study as follows:

> In this paper, we ask the question: how susceptible are current jobs to these technological developments? To assess this, we implement a novel methodology to estimate the probability of computerisation for 702 detailed occupations. Based on these estimates, we examine expected impacts of future computerisation on labour market outcomes, with the primary objective of analysing the number of jobs at risk and the relationship between an occupation's probability of computerisation, wages and educational attainment.' (Frey & Osborne, 2013, 44)

A distinction is made between high, medium and low risk occupations, depending on their probability of automation. Despite the predicted year of 2033 referred to by Handman (2016), Frey & Osborne (2013, 44) are actually less precise with their estimate. They simply refer to 'the next decade or two' as the timeframe when the jobs at risk are predicted to be automated, and estimate a total of 47 percent of total US employment as is often cited.

In their analysis the variables used by Frey & Osborne (2013) to evaluate each occupation's likelihood of automation include ideas such as 'fine arts', 'originality', 'negotiation', 'persuasion', 'social perceptiveness', 'assisting and caring for others', 'manual dexterity', 'finger dexterity' and 'cramped work space'. Based on the levels of risk attached to each variable there is an observation that '…generalist occupations requiring knowledge of human heuristics, and specialist occupations involving the development of novel ideas and artifacts, are the least susceptible to computerisation' (Frey & Osborne, 2013, 40). This kind of evaluation is supported by Willcocks (2016, 287), who argues that jobs least at risk of automation include qualities that 'computers are less good at' such

as '…tasks involving manipulation, dexterity, perception, meta-cognition, pattern recognition, substantial contextual and historical information, and/or creative or social intelligence.'

The specific jobs Frey & Osborne (2013) identify as being most at risk include workers in transportation and logistics occupations, the majority of office and administrative support workers and production workers, as well as a 'substantial share' of employment in service occupations. Ford (2015, 15) supports this view in relation to the service industry, with this prediction: 'Given that companies like Foxconn are introducing robots to perform high-precision electronic assembly in China, there is little reason to believe that machines won't also eventually be serving up burgers, tacos, and lattes across the fast food industry.' Raising important economic questions, Frey & Osborne (2013) predict that in the short-term automation will be '…principally confined to low-skill and low-wage occupations.' This idea of a disproportionate impact on low-wage occupations was recently echoed in a report by the U.S. Council of Economic Advisors, which estimated that 83 percent of jobs paying less than $20 per hour could be automated (McAfee & Brynjolfsson, 2016).

Frey & Osborne's (2013) results have since been adapted to analyse jobs in the UK, with the result that 35% of current jobs were judged to be at high risk (Stylianou, N., Nurse, T., Fletcher, G., Fewster, A., Bangay, R., Walton, J., 2015). Particularly relevant to this dissertation is the inclusion of 'Library clerks and assistants' and 'Librarians', with the former being given a 97% likelihood of automation, and the latter 52% in the estimates for the UK (Stylianou, N., Nurse, T., Fletcher, G., Fewster, A., Bangay, R., Walton, J., 2015). See Figures 1 and 2 for the way this data was presented in an interactive feature on the BBC website. There is a distinction made between different types of library work, but even the professional level librarian role was found to be at some risk, based on the aforementioned variables.

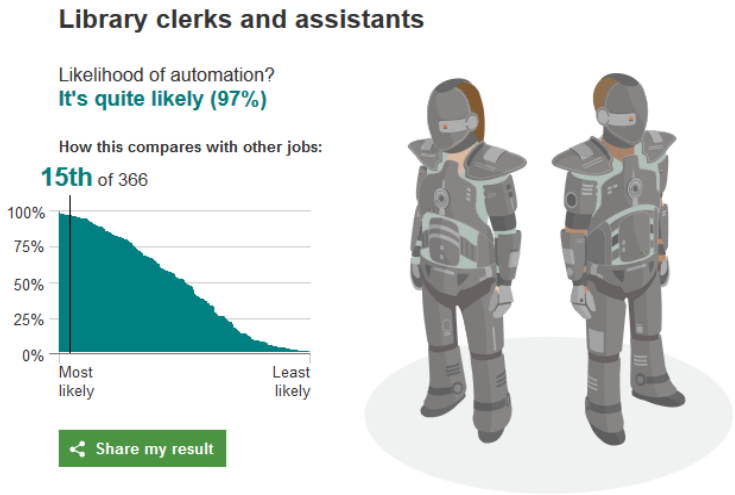

Figure 1: result for 'Library clerks and assistants' on BBC interactive story 'Will a robot take your job?' (Screenshot taken on 10th August 2016 from: http://www.bbc.co.uk/news/technology-34066941)

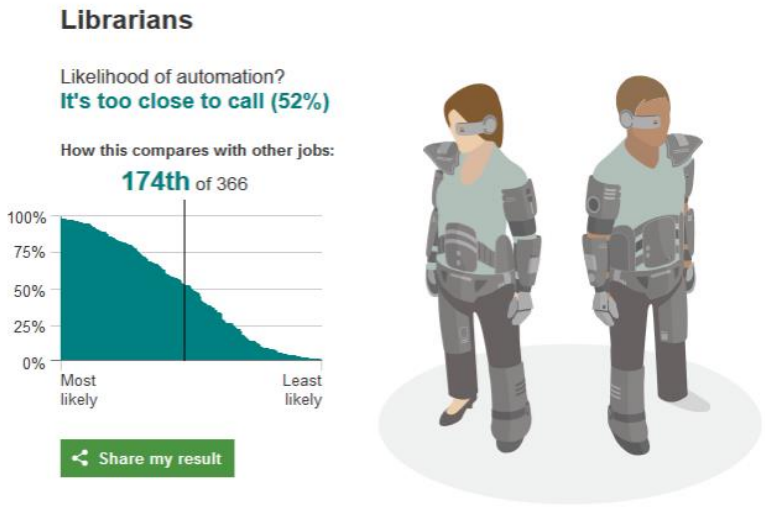

Figure 2: result for 'Librarians' on BBC interactive story 'Will a robot take your job?' (Screenshot taken on 10th August 2016 from: http://www.bbc.co.uk/news/technology-34066941)

A slightly different approach is taken in a report by Chui, Manyika & Miremadi (2016), which looks at the proportion of activities within particular occupations that could be automated, rather than the likelihood of the job as a whole being automated. They claim that 'analyzing work activities rather than occupations is the most accurate way to examine the technical feasibility of automation' (Chui, Manyika & Miremadi, 2016). Feasibility is a key concept here, and the researchers make their predictions for levels of automation based on the feasibility of '…adopting currently demonstrated technologies' for different activities.

Chui, Manyika & Miremadi (2016) claim that 45% of the activities people are paid to perform could be automated, and that around 60% of all occupations could see 30% or more '…of their constituent activities automated, again with technologies available today'. They also identify the percentages for different roles in particular industries, for example stating that within manufacturing 90% of what welders, cutters, solderers, and brazers do has the potential for automation, but only 30% of the activities carried out by customer-service representatives (Chui, Manyika & Miremadi, 2016).

As with Frey & Osborne (2013), Chui, Manyika & Miremadi's (2016) report identifies the qualities which currently make automation most difficult: 'The hardest activities to automate with currently available technologies are those that involve managing and developing people (9 percent automation potential) or that apply expertise to decision making, planning, or creative work (18 percent)'. The importance of human interaction for particular roles, and how this cannot be realistically replicated by a machine, is highlighted, with a particular emphasis on the education and healthcare sectors (Chui, Manyika & Miremadi, 2016). As well as technical feasibility, Chui, Manyika & Miremadi (2016) also point out several other key factors in trying to predict the extent of automation, such as cost-benefit analyses, the supply-and demand dynamics of labour, and issues around acceptability linked to regulations and social attitudes.

While much of the discussion around the potential impacts of automation has focused on developed countries, there should also be a consideration of how developing countries will be affected, with Ford (2015, 222) pointing out that the poorest countries in Africa and Asia may particularly struggle '…in a world that no longer needs untold millions of low-wage factory workers.' Willcocks (2016, 254) makes a similar observation:

> Overall, the likely effect on jobs will be the elimination of those involving rote, repetitive processing, and a higher focus on the value human workers who can deliver results in jobs requiring creative thinking and subjective decision-making. Any countries whose economies are dependent on jobs in the former category, without the ability to shift to the latter, will be adversely affected.

A report from the United Nations Conference on Trade and Development also predicts that the number of jobs in developing countries will be disproportionately affected by automation, unless they are able to rapidly modernise and adapt to new technologies (UNCTAD, 2016).

The potential for increased automation has been identified by companies such as Xerox (2016) as an exciting indication of the ways that new technologies '…will transform knowledge work, helping analyse, evaluate and solve problems at unprecedented speed and scale,' and can offer potentially huge increases in productivity and profitability. However, taking into account the great uncertainty about how employment rates may be affected, there are differing views about whether these advantages can benefit all of humanity, or just a small percentage made up of technologists and business owners, as shall be discussed.

2.1.4. A utopian or dystopian future?

Although there may be some debate around the extent to which automation is going to displace human labour in the coming years, there is certainly evidence that it is happening at an increasing rate, as the technology that is enabling it continues to advance. When considering the future, it is important to recognise that the automation of work, and technological progress in general, can be seen as either a negative or a positive goal for humanity, depending on a range of political, economic and social factors.

As has already been discussed, the debate around AI has led many to stress that a cautious approach should be taken, epitomised by fears of a technological 'singularity' where machines surpass humans in intelligence and lead to our destruction. This has recently been acknowledged as a genuine concern by key figures:

> Elon Musk and Stephen Hawking are among 8,600 people who have signed an open letter about the potential dangers of AI. The letter describes the need for safeguards to ensure that AI is positive rather than neutral in respect to purpose, but it also calls for the maximization of the societal benefit of AI. In short, it calls for social responsibility (Handman, 2016).

As was seen with Floridi (2014, 2016) and Kaplan (2015), this does not necessarily indicate a fear of machines actively rising up against humans, but a more realistic recognition that increasingly 'smart' machines could have very serious implications for the future of humanity, even if they themselves are not aware of this.

Floridi (2016) may be dismissive of the possibility of the singularity, but he is equally critical of those who would choose to ignore the potential risks of AI (who he describes as AItheists): 'Singularitarians and AItheists will continue their diatribes about the possibility or impossibility of true AI. We need to be tolerant. But we do not have to engage. As Virgil suggests in Dante's *Inferno*: 'Speak not of them, but look, and pass them by.' For the world needs some good philosophy, and we need to take care of more pressing problems.' This kind of philosophical approach is also taken by the University of Sheffield (2016) in their recent online course on robotics: '...it is paramount that the scientists, researchers and manufacturers develop a socially responsible attitude to their work and promote ethical and societal principles of fairness and justice to ensure that robotics has a successful future in helping humanity.'

As well as the big questions about the existential risks of AI, and the call for a generally responsible and ethical approach to robotics, there are also specific ethical concerns. Bollegala (2016) highlights potential problems with AI working alongside humans in increasingly complex tasks, with the idea that 'it is one thing getting a face incorrectly recognised in an image uploaded to Facebook, but a totally different matter if cancer is misdiagnosed by an AI.' The ideas of responsibility and culpability are key, and this is also highlighted by Kaplan (2015, 10), albeit slightly more light-heartedly: 'The emergence of synthetic intellects and forged laborers that act as our individual agents will raise a raft of practical conundrums. What should "one per customer" mean when a robot is the customer, and I own a whole fleet of them? Can my personal electronic assistant lie on my behalf? Should it be required to report me if I direct it to serve my twenty-year-old daughter wine at Thanksgiving dinner?'

A classic ethical dilemma is often used when considering self-driving cars, in terms of who the car would 'choose' to save or hit in a collision and who would be liable for this decision. However, it can also be argued that these kinds of ethical concerns will be far outweighed by benefits such as thousands fewer deaths caused by human error when driving (Xerox, 2016). These issues are certainly important, and will undoubtedly continue to be debated in the coming years as robots and AI become more ubiquitous.

As discussed, the potential impact of automation on the labour market is also being widely discussed, and possible solutions for the disruption that this will cause are being suggested. Based on the evidence we have seen thus far it seems to be a reasonable prediction that there may be '…a significant reduction in demand for workers,' due to an emerging wave of automation (Srnicek & Williams, 2015, 111). With regard to whether or not increased automation will be a good or bad thing there are a range of views, from those who argue that advances in robotics and AI will actually lead to more (and more interesting) jobs for humans as we are needed to develop and maintain increasingly complex machines, to those who believe that we should be pushing for full automation and the end of human work altogether.

On the optimistic side of the spectrum is Willcocks (2016, 230), who makes the following claim:

> The human brain is the ultimate Darwinian engine. When mundane chores are no longer available, man will be forced to elevate his game and retool his skills to be more productive in an automated world. When automation delivers 60 percent more value, the luddites need to ask if we have a choice of turning against such an automation tide. We need to embrace the automation tide that is coming. It will lift all embracing companies' ships.

Here we see the perhaps clichéd use of the term 'luddites', dismissing the arguably valid concerns of those who may have reservations about automation. Willcocks (2016) is arguing that automation is inevitable as it will increase companies' profits, and this will in turn push people to develop new skills whether or not they choose to.

A similar rebuttal to the 'robots will steal our jobs' argument is shared in an article from Xerox (2016): '…there are reasons to be optimistic. Bots can take away a lot of our drudge work, allowing us to automate routine tasks and make us all faster, better and even more intelligent.' Bollegala (2016) likewise argues that 'Letting machines do the bulk of the work means that humans will be freed from routine tasks that computers are better at performing with higher accuracy rates, such as driving cars.' The idea of freeing humans from mundane work is a key one in debates around the positives or negatives of automation, but there is also an acknowledgement of the potential limitations of so many people needing to be trained in new skills (Willcocks, 2016). Also, referring to Frey and Osborne's work, Willcocks (2016, 263) observes that it is not clear '…how many jobs may change their structures as a result of automation and robotics, rather than be lost altogether.'

An interesting compromise is predicted by Professor Manuela Veloso, head of the machine learning department at Carnegie Mellon University, who '…envisions a future in which humans and intelligent systems are inseparable,' with the idea of 'symbiotic autonomy', whereby 'neither people nor software will be much use without the other' (Brandom, 2016). The idea of 'symbiotic autonomy' is also supported by Bollegala (2016), who claims that 'AI systems have already become far too complicated for the average person to understand, let alone repair, so there will be new roles created which will require people who can act as intermediaries between computers and humans.' However, there are those who argue that despite some new jobs being created, the eventual result of the types of automation being predicted will be far more robots and machines, and far fewer jobs for people (Ford, 2015, 21).

If there will be a net loss of human jobs in future, how will our current economic systems cope, and how will the financial benefits of automation be shared across the population, if at all? Srnicek & Williams (2015, 129) are not optimistic as things stand: 'Under current conditions, automation is likely to cause more unemployment, with the benefits of new technologies going to their wealthy owners'. This is supported by Das (2016) with the prediction that an 'elite' 5% will benefit from changes in the workforce, while the majority of the population …survives rather than prospers in an essentially subsistence existence.' Kaplan (2015) also identifies the potential for suffering if changes are not made, and stresses that as automation increases '…it's essential to distribute the benefits of our increased wealth beyond those who land the remaining good jobs or are lucky enough to accumulate private assets.'

Despite fears that our current systems may not be capable of supporting the population as a whole should automation continue to increase, there is also an argument that fundamental changes could be made to achieve full automation and the end of human work altogether. The idea of reducing human labour is certainly not a new one, but has usually involved suggestions of a shorter working week, whereby the cost savings brought about by using robots and other forms of automation would mean the economy could afford for people to be paid the same while working fewer hours (Willcocks, 2016). In their book Srnicek & Williams (2015) present the more radical concept of an ideal future where humans no longer have to work, but they qualify this as follows: 'Whatever approach is taken, though, the point is that labour will not be immediately or entirely eliminated, but instead progressively reduced. Full automation is a utopian demand that aims to reduce necessary labour *as much as possible*' (Srnicek & Williams, 2015, 114).

An increasingly popular idea, although only currently being implemented on a small-scale, experimental level, is that some kind of basic income (BI) should be introduced to ensure that everybody has the means to survive comfortably regardless of whether or not they are employed (Handman, 2016). Ford (2015, 268) describes BI as 'the most effective solution' for joblessness from automation, with the following proviso: 'I don't see anything especially dystopian in offering some relatively unproductive people a minimal income as an incentive to leave the workforce, as long as the result is more opportunity and higher incomes for those who do want to work hard and advance their situation.' He argues that BI would not necessarily mean that everyone would want to stop working, and that our fears of people riding for free in 'the economic wagon' and not 'pulling it' should be reduced '…as machines prove increasingly capable of doing the pulling' (Ford, 2015, 278).

Srnicek & William's (2015, 118) idea of a fully automated economy is not only promoted as a way 'liberate humanity form the drudgery of work,' but they also suggest it would simultaneously produce enough wealth to introduce a truly universal basic income (UBI) '…giving every citizen a liveable amount of money without any means-testing.' They argue that the funding of UBI may seem to be a huge problem, but that research suggests this could easily be done through higher tax rates for the rich, higher inheritance, consumption, and carbon taxes, cutting military spending,

agriculture and industry subsidies, and reducing duplicate welfare programmes (Srnicek & Williams, 2015, 123). While figures such as Willcocks (2016) have argued that automation should be encouraged from a corporate perspective, and the idea that it will free humans to do more interesting work, Srnicek & Williams (2015) are suggesting that we should actually be aiming for a utopia where humans do not need to work at all, and that wealth could be distributed fairly and evenly through UBI.

Others, such as McAfee & Brynjolfsson (2016), have argued against the idea of UBI and think we should '…directly encourage work instead of planning for its obsolescence.' They refer to Voltaire's ideas of the benefits of work, but also observe that Frey & Osborne's (2013) study '…would certainly seem to call for radical policy changes' (McAfee & Brynjolfsson, 2016). Claiming that the kind of wide scale UBI proposed by Srnicek and Williams is 'unworkable' based on current levels of national income in the USA, McAfee & Brynjolfsson (2016) suggest an alternative policy of wage subsidies that would encourage people to work while mitigating the impact of automation reducing the work available. Although there may be differing views on the economic and social solutions for increased automation of work, we can see that across the board there is an awareness of the need to proceed with caution, and the fact that certain groups of people could be more negatively affected if appropriate changes to our current systems are not made.

2.1.5. Public perceptions

In examining the potential impacts of automation it is crucial to consider the various ideas of particular writers and researchers, as has been discussed, but it is also important to consider how the public as a whole feel about the kinds of changes that are taking place. As smart machines have begun to enter the mainstream, it is interesting to consider whether opinions of them are based on an accurate interpretation of the facts, or on misconceptions. An important part of this is to consider the role of anthropomorphism:

> The tendency to think of AI systems in general and robots in particular as analogs of human brains and brawn is understandable, but it carries significant dangers. The field has a long history of exploiting our natural tendency to anthropomorphize objects that look or act like us in order to attract attention and increase funding. But it also misleads people into believing that machines are more like us than they really are, and into assuming that they are capable of understanding and abiding by our social conventions (Kaplan, 2015, 36).

There is an argument that this phenomenon is unhelpful, as it causes misunderstanding and prevents serious debates taking place about the very real kinds of policy issues that are now appearing surrounding AI.

As previously discussed, people's general acceptance of new technologies can be just as important as its technological feasibility in predicting whether or not the technology will actually be implemented. An example is given by Chui, Manyika & Miremadi (2016): 'A robot may, in theory, be able to replace some of the functions of a nurse, for example. But for now, the prospect that this might actually happen in a highly visible way could prove unpalatable for many patients, who expect human contact.' Bollegala (2016) shares the view that technical feasibility is not the only factor in the potential for automation, with social and cultural factors also playing a huge part in whether or not people will accept robots as co-workers. In his study on RPA, Willcocks (2016) reports that when employees in companies adopting RPA were reassured that this would not result in layoffs, and were given more interesting work to do, they did not feel threatened, and even said they viewed the 'robots' as teammates. This is a real-life example of the arguments presented in the previous section, that automation can be seen as a good thing when it releases people to do more interesting things and does not remove their job completely, but it should be recognised that this is based on a

limited sample and comes from a study which arguably presents a corporate-centric view of automation.

As well as the anecdotal and qualitative examples available, there have also been several large-scale studies in recent years attempting to gauge public attitudes towards robots and AI, with a focus on the acceptability of different kinds of robots in areas of human life, and the fear of robots 'stealing' human jobs. The European Commission carried out two surveys across Europe in 2012 and 2014 (with the results of the latter being published in 2015), aiming '…to gauge public opinion towards robots by measuring public perceptions, acceptance levels, worries and reservations among EU citizens aged 15 and over in the 27 Member States' (European Commission, 2012, 2). With a representative sample of over 25,000 respondents for each survey, the data can be seen as an invaluable source of information on this topic. As with authors such as Winfield (2012) and Kaplan (2015) the study states that 'public perceptions of robots, are…often influenced by misconceptions and fears,' and that there was a desire '…to improve the image of robots and to increase public acceptance,' to ensure the future economic success of Europe, which they see as dependent on the use of robotics (European Commission, 2012, 2).

The original 2012 survey was designed to measure respondents' interest in scientific discoveries and technological developments; their familiarity and personal experience with robots; their general and more specific attitudes towards robots; their opinions on which areas robot should be used in and where they should be banned; their potential acceptance of different tasks being done by robot; and finally their predictions for when robots will become more common (European Commission, 2012, 2). The 2014 survey was intended as a follow-up to the original, so has a similar format, with the omission of the questions about respondents'' interest in scientific discoveries and technological developments, and the addition of questions about their attitudes towards autonomous cars and civil drones (European Commission, 2015, 4).

Some of the key findings from the 2014 survey are explained as follows, with comparisons to the original survey:

> Overall, personal experience of robots is rising: one respondent in seven has now used a robot, up from one in eight in 2012. It's also clear that the experience of robots is strongly related to the attitudes of and perceptions towards the use of robots in daily life. Generally, those who have more experience with the use of robots, whether it be at home, at work or elsewhere are more positive towards their uses. However, a large proportion of respondents still have misgivings about the potential uses of robots, such as their use to help care for the elderly or their use in medical procedures (European Commission, 2015, 58).

The finding that certain uses of robots are less acceptable than others arguably supports the claims of Chui, Manyika & Miremadi (2016) and Bollegala (2016), that it is not only technological feasibility that is a factor in predicting what jobs can be automated. The study also found that the majority of respondents had a positive general view of robots, but that the proportion expressing a positive view had dropped since the original survey, from 70% to 64% (European Commission, 2015, 58). This could suggest that even though exposure to robots was correlated with greater positivity towards their potential uses, people as a whole had nonetheless become slightly more negative towards them.

With regard to employment it is reported that generally respondents do not think their current job could be done by a robot in future, with a third thinking it could be done at least partially, but less than one in twenty thinking it could be done fully (European Commission, 2015, 58). This apparent confidence is tempered somewhat with the finding that most respondents also felt that robots take jobs away from people, suggesting an awareness of the rise of automation even if they themselves did not feel directly threatened. However, it is also argued that most respondents could see the

benefits of robots '…with most recognising that they can do jobs that are too hard or too dangerous for people, and also that robots are a good thing for society because they help people' (European Commission, 2015, 58).

A similar survey was carried out on behalf of the British Science Association (BSA) in 2015 '…to see how the public thought robotics and artificial intelligence will affect society and culture' (British Science Association, 2015). The survey received over 2,000 responses, and asked questions about the predicted impact of AI on the job market, the possibility of robots being equipped with emotions or personality, whether respondents would trust intelligent machines in particular job roles, and their levels of optimism for the future of AI.

With regard to work, the BSA survey found that 'many of the respondents felt negatively about the short term effects of the rise of artificial intelligence' with 60% thinking that the rise will lead to fewer jobs by 2026, and 27% predicting that it will decrease the number of jobs 'a lot' (British Science Association, 2015). This is similar to the European Commission finding that a majority of people think 'robots steal people's jobs'. There were also interesting findings on the levels of acceptability of certain roles, finding that respondents would have low levels of trust in intelligent machines taking on roles where lives could be at risk, with 53% who would not trust them to carry out surgical procedures, 49% who would not trust self-driving public buses, and 62% who would not trust them to fly commercial aircraft (British Science Association, 2015). Again we can see that despite the technological feasibility of these tasks, there are other important factors in whether or not they will be accepted.

Lord David Willetts, Chair of the BSA acknowledges the worries shown by the respondents to the survey: 'What this research shows is that the public's fears need to be listened to as we go on to innovate and trail-blaze in this area…the public should be involved in the debates around future technology to ensure they have a voice and to give the public some ownership of the direction of science and technology,' demonstrating similar motivations to the European Commission, and the desire to reassure people (British Science Association, 2015). Regarding employment, Lord Willetts even goes so far as to claim that 'People will always want human experiences: robots will not kill the radio star, and we will always want to interact with other people. In fact, the greater problem is that artificial intelligence cannot quickly enough fill jobs that are going spare' (British Science Association, 2015). This reflects the more positive view held by some that robots and AI will be beneficial to humanity overall, and that there will not be a shortage of work for humans. While there were some positive views about robots, AI, and the future of work expressed in this survey, as well as the surveys of the European Commission (2012, 2015), it can also be seen that many respondents had reservations and fears for the future, as was also expressed by many in the literature.

2.2. Technological changes in libraries, potential and real uses for robots and AI in libraries, and predictions for the future of library work

2.2.1. Brief history of technological change and automation in libraries

As was demonstrated in Frey and Osborne's (2013) research, library jobs are certainly included in the kind of work that may be increasingly at risk of automation, if the various predictions around the increasing capabilities of AI and robotics are correct. As with many other fields, automation of library work is by no means a new phenomenon, and various technologies have been introduced which have already greatly changed the way that library workers operate. These include computerised library systems, digital information, the internet, self-service and RFID (Palmer, 2009; Lewis, 2016).

As outlined by Lewis (2016, xviii) the end of the twentieth century saw many libraries transition from the 'Paper Library' to the 'Automated Library', described as 'a massive undertaking' where 'card catalogs and other files were converted from hundreds or thousands of drawers full of hundreds of thousands - sometimes even millions - of cards to digital files in computer systems.' Lewis (2016, xix) highlights the development of Machine Readable Cataloging (MARC) as a key part of this, as it created the framework for library automation, and he argues that 'The sharing of cataloging data and the general automation of library back-office operations was an escape from crushing personnel costs and it was worth the disruption that came with it' (Lewis, 2016, xix). There is an acknowledgement here that technological changes and the initial work to allow automation can be disruptive and actually create more work for people in the short-term, but that the long-term benefits make this worthwhile.

From the Automated Library, Lewis (2016, xix) describes the next big transition over the past twenty years as being towards the 'Electronic Library', describing the dawn of full-text databases, followed by full-text journals and then electronic books, with some content predating the web and being migrated onto it but mostly being 'born on the web'. The rise of the internet has of course played a huge role in changing the ways that libraries operate, with Palmer (2009, 11) stating that it has 'fundamentally' changed traditional approaches to information management, and that '…from the point of view of many members of the public, it has been sufficiently disruptive for them to believe that it has done away with the need for libraries altogether.' While there may be a general feeling that the internet has posed a potential threat to libraries, there is also research that suggests this may not be the case, with Waldman (2014) citing a 2013 report that showed 81% of Americans thought that 'public libraries provide services they would have a hard time finding elsewhere.' Either way, it is undeniable that the movement towards computerised systems and digital resources has had a significant impact on library work, removing the need for much of the routine administration work that used to be required to keep the old systems in operation.

Although the movement towards electronic resources has certainly had a huge impact on the way that libraries work, much of what libraries do still revolves around the provision and circulation of printed materials. As discussed, a big change came with the movement to automated library systems, allowing library staff and users to keep track of material they have borrowed or requested, and to search for resources, in much quicker and easier ways than was allowed by the old physical card catalogue and circulation systems. Another key technological change, which we will see is particularly important in terms of the prospects for robots to work within libraries, is the rise of Radio Frequency Identification (RFID) within libraries.

Although RFID is by no means a new technology, having existed since 1948, it has only been implemented on a large-scale in libraries within the past decade (Fortune, 2016a). Palmer (2009, 1)

writes that 'few, if any, technologies have had as immediate an impact on libraries as that of Radio Frequency Identification (RFID)'. He believes that '…most developments in lending-library technology since the introduction of open access can be seen to have been only 'sustaining', providing (usually but not always) better ways – Browne, photo-charging, barcodes – of recording transactions and devising procedures to provide various added-value services and/or save staff time' whereas RFID carries much greater potential, with applications beyond simply monitoring circulation (Palmer, 2009, 12).

Fortune (2016a) argues that RFID should not just be seen as a technology for self-service: 'If you look at what you can do with RFID in a library it offers so much, such as, for example, storing significant amounts of data at a quite granular level.' Palmer (2009, 12) makes a similar observation, but acknowledges that self-service is the most popular function: 'Although the description of the RFID tag as a combined barcode/security device is not only simplistic and limiting in terms of realizing other potential applications, the customer-friendly self-service made possible by this combination of features is certainly at the heart of the attraction of RFID for most libraries.' Although self-service in libraries can exist without RFID, the evidence suggests that the alternative barcode-based systems are nowhere near as well-used, with Palmer (2009, 82) citing a survey which found that '…most libraries using barcode-based systems achieved self-service levels below 10% of total issues - with self-return not usually featured at all.'

Palmer (2009, 63) also discusses the potential benefits of RFID enabled self-service for staff, such as fewer instances of repetitive strain injury (RSI) from handling books, and '…the creation of more interesting and less tedious tasks for staff, freed from the need to perform routine counter duties, and so resulting in more enjoyable and less stressful time at work.' Again we return to the argument that freeing up workers from mundane tasks is beneficial as it means they can do more interesting work. Palmer (2009) goes on to discuss this in great depth, giving examples from a case study in a public library where the roles of frontline library staff were completely redesigned on the basis that a push towards complete self-service would free up a lot of their time to provide much more tailored customer service to their users. Palmer (2009, 80) also highlights the need for careful change management, stating that '...the danger of simply automating existing procedures rather than undertaking a fundamental re-engineering of processes is that the full benefits of the technology may never be realized,' and acknowledges the need to provide good support to staff and appropriate training, so they do not feel threatened by changes.

Others are slightly less positive about the use of self-service in public libraries in the UK: 'Unlike the public sector universities and colleges have introduced self-service to improve services and increase interaction between staff and users – rather than simply replacing staff with machines…It seems to me that the UK is almost unique in the Western World in being bent on destroying its public library service' (Fortune, 2016a). There is a complex debate around whether or not the implementation of self-service can be seen as a cause or an effect of reduced library staff budgets, but it is important to recognise that people's perceptions are shaped by the way new technology is implemented, and the support that is given when their roles are directly affected.

As well as the benefits of RFID for self-service, Palmer (2009) also points out that the level of processing done to books can be reduced in a full RFID-based system, as data can be loaded on to tags meaning separate date labels, barcodes, and security tags would no longer be needed, again saving much staff time. Another potential application is using RFID to monitor the locations of books on the shelves, but there are currently recognised limitations with the technology and costs involved:

> Hand held RFID readers replace human eyes by using a communication device to identify the book via the RFID tags that were embedded on the books; nevertheless the task is still time

> consuming and the user still cannot easily interpret the RFID results to see if the books are sequenced properly. Smart shelf, on the other hand, uses many RFID antennas that are placed at many strategic locations so as to scan the RFID tags. The high infrastructure cost and implementation complexity remains a barrier for this technology to be widely adopted.' (Li, Huang, Kurniawan & Ho, 2015)

There are certainly examples of smart-shelves being used in libraries, with Fortune (2016a) highlighting their use at Oslo's Deichman Public Library, but at this point they have not been widely implemented due to the barriers mentioned above. While RFID technology may be arguably under-utilised in libraries as things stand, there is clearly potential.

When examining the current technological state of libraries and their potential susceptibility to further automation, we can consider Floridi's (2014) concept of the 'infosphere'. We can see that the technology already in place in libraries, such as increasingly digital collections with the capability for full-text searching, and physical items with remotely readable RFID tags, is arguably creating an 'infosphere' within libraries, ready for smart machines to operate in. As we shall see, this does not mean that all tasks carried out by library workers could necessarily be done by a machine, but we will now consider some specific examples where technology already exists, or is being developed, which could lead to further automation in libraries.

2.2.2. Examples of robots/AI which are particularly relevant to libraries

As has been discussed there are now many examples of robots and AI which are beginning to enter various working environments beyond the traditional routine manual and cognitive spheres. Although there are relatively few physical robots or advanced AI applications currently being used in libraries, some examples of which will be examined below, there are many others being used or developed where we can see potential future uses in libraries.

As far back as 1985 predictions were being made that the existing robots of the time could potentially be relevant for library work: 'Robots are used in many areas — some of those equating with certain library tasks (eg. book unpacking, sorting, shelving) including bottle handling; loading bricks into oven cars consisting of twelve shelves; taking items (e.g. jars) from cases and sorting and stacking them or putting them in a line for further action; and taking a work piece from the end of a conveyor belt to a lathe, then on to a second lathe, next to a drilling station and finally on to an output station' (Raitt, 1985, 280). Industrial robots were already being widely used at this point, but Raitt (1985, 281) also identifies other potentially relevant examples, such as a shelf-stacking robot in a Japanese supermarket and a 'Mailmobile' which was able to deliver paperwork around an office and '…could be adapted for use in libraries for transporting books and other materials between the various processing points'. Raitt's predictions for the adoption of robots in libraries may have been slightly premature, but as will be shown they now seem perfectly reasonable.

The issue of physical manipulation is a key one for automating library work, in terms of being able to deal with a range of different library materials and shelving arrangements. Companies such as Amazon are using robots on a huge scale in their warehouses, which '…can lift up to 750 pounds, and reach high shelves that Amazon's human workforce would struggle to get to,' and this has direct parallels with some of the book storage and retrieval systems to be discussed (Xerox, 2016). Use of robots is not limited to simple lifting and carrying, as Frey and Osborne's study points out:

> More advanced robots are gaining enhanced sensors and manipulators, allowing them to perform non-routine manual tasks. For example, General Electric has recently developed robots to climb and maintain wind turbines, and more flexible surgical robots with a greater range of motion will soon perform more types of operations.' (2013, 20)

There have also been experiments with swarm systems, made up of networked specialist robots that can adapt to their surroundings, with this example holding obvious relevance for libraries: 'In what

was almost certainly the world's first demonstration of a heterogeneous swarm system collaborating to achieve a complex 3D task, the Eye-bot coordinated a group of Foot-bots and a Hand-bot to locate and fetch a book from a high bookshelf' (Winfield, 2012, 93).

As well as robots being used for increasingly complex physical tasks, the aforementioned advances in computing power, sensors and speech recognition have also led to more capable machines which can interact directly with humans in an office environment, such as the CoBots described here:

> Our robots purposefully include a modest variety of sensing and computing devices, including the Microsoft Kinect depth-camera, vision cameras for telepresence and interaction, a small Hokuyo LIDAR for obstacle avoidance and localization comparison studies…a touch-screen and speech-enabled tablet, microphones and speakers, as well as wireless signal access and processing.' (Veloso et al., 2012, 5446)

The CoBot is an example of the previously raised idea of 'symbiotic autonomy', whereby it is not designed to replace human workers, but to operate alongside them and carry out tasks such as escorting guests around office buildings, delivering messages, and transporting post. Ford (2015, 163) also discusses the possibility for 'robot helpers' for older people or people with disabilities, offering functions such as assisting with mobility, and fetching items such as medicine or spectacles, which could be achieved with the use of RFID tags. There are obvious potential applications for these kinds of services in libraries, such as helping users to locate books, as we shall see.

As well as physical robots that may be suitable for carrying out certain library work, there is the idea that 'not all robotics involves robots' such as the example of Robotic Process Automation (RPA). Willcocks (2016, 65) argues that RPA is '…ideally suited to replace for so-called 'swivel chair' processes,' described as '…processes where humans take inputs from one set of systems (such as email), process those inputs using rules, and then enter the outputs into systems of record' (2016, 65). Acting on top of existing software in the same way a human does, but with the obvious advantages of not becoming bored or tired, RPA could have potential applications in libraries if it could be connected to Library Management Systems or email accounts, such as processing new user records, or helping to deal with enquiries.

Alongside RPA there have also been developments in AI that can communicate directly with customers:

> Automation and artificial intelligence have made huge advances in customer service over the last few years. Virtual agents are a new generation of self-service customer-care tools that improve continuously, ensuring each interaction is better than the last. They learn from human interactions, discovering solutions faster while automating routine tasks. They aggregate customer information from a wide variety of sources to personalise service. And in the future, they'll detect a customer's tone of voice and adjust their responses for greater levels of empathy (Xerox, 2016).

Again, we should take care when evaluating evidence from corporations such as Xerox, who arguably have a vested interest in presenting automation in a positive light. However virtual agents, or chatbots as they can also be known, are undoubtedly becoming more advanced and widespread, as argued with Winfield (2012, 127) writing that 'modern online chatbots are surprisingly diverting,' and giving the example of the online Artificial Linguistic Internet Computer Entity (ALICE).

As well as being used by big companies for customer service, the technology behind virtual agents is increasingly entering the home and mobile market in the form of digital assistants, as described by (Stucke & Ezrachi, 2016) who predict that in the future we may no longer search for information ourselves but 'Instead we may rely on our butler, namely the intelligent, voice-activated digital assistant on our smart phones, smart watches, or devices like Amazon's Echo and Alphabet's Home.' Although assistants such as these, perhaps most famously Apple's Siri, have been around for several

years, there is a general feeling that they are about to become far more widespread, and able to connect to and operate an increasing number of devices and other technologies in the home and elsewhere through the 'Internet of Things'. One commentator recently explored the potential uses in libraries of Amazon's Alexa, such as providing tailored information services to users, with the following conclusion: 'There are still plenty of limitations to this kind of consumer-focused device but voice activation and integration with smart devices and other services is an interesting development with lots of potential for improving how users can interact with collections and other library and museum services' (Lomax, 2016).

Connected to these advances in digital assistants is the ongoing development of deep learning systems, which are behind technological capabilities such as speech recognition and pattern analysis (Ford, 2015). Perhaps the most advanced and well-known example of a deep learning system is IBM's Watson, which is being used for a range of functions including medical diagnosis. As of 2013 Watson had access to a huge amount of scientific literature, and an 'unparalleled natural language interface' with the ability to rank its top answers with confidence intervals, and for humans to query it about where and how it got those answers (Willcocks, 2016, 48). This has obvious implications for the kinds of service offered by libraries, with the algorithms behind systems such as Watson not only offering an advanced literature searching service, but also entering into the realms of information literacy. Other examples of similar systems include Semantic Scholar, which is described as '…a search engine that reads the literature on its own, picking out topics and influences, ranking citations, and making it much easier to find both the latest and what you're looking for' (Coldewey, 2016), and ROSS, which is actually powered by Watson but targeted specifically at the legal sector, as an 'AI-enhanced legal research service' (DeAizpura, 2016; Mirando, 2016).

Commentators such as Ford (2015) have noted that the development of advanced research tools has already had an impact on the legal sector, reducing the number of jobs for paralegals who would have previously spent hours searching for documents. DeAizpura (2016) recognises that this also has implications for law librarians, but argues that they still have valuable skills which cannot be so easily automated:

> Artificial intelligence systems like Watson and ROSS, no matter how sophisticated their computing algorithms, will ultimately depend on good information to be successful. Information is what librarians "do". As "information scientists" (to use a dated term), librarians are trained in the skills and also the arts of retrieving, analyzing, describing, organizing and structuring data. Added to these hard skills are the soft skills that have always been signatures of the library profession: teamwork, collaboration and a commitment to service.

The recurring themes of considering which skills can be easily automated, and which cannot, emerge again here, and DeAizpura demonstrates that this is a nuanced and complex task. This is a key issue, which will also be considered when looking at the following examples of robots that have been implemented in libraries.

2.2.3. Examples of robots/AI already being used in libraries

Unlike when Raitt (1985) was making his predictions, there are now several examples of robots and AI which have been implemented in libraries, some of which are well-established and some still at very much an experimental stage. There will be a consideration of their success so far, and how they have been received. The examples below cover tasks such as shelving, book locating, security, enquiries and training.

The most widespread use of physical library robots has been seen with the rise of automated storage and retrieval systems (ASRSs), which have become increasingly popular as a solution for space pressures in libraries over the past two decades (Payne, 2007). Writing in 2007 Payne was able

to list 15 such facilities in the US alone, and there are many other examples across the world (Nagy, 2015). This is a description of how one such system operates:

> The National Newspaper Building was purpose-built to provide the ideal environmental conditions in which to store millions of old newspapers – many of which are in a fragile state. The vast facility, which houses around 33km of newspapers, maintains constant temperature and humidity, and a dark and airtight, low-oxygen environment to eliminate the risk of fire. The newspapers are stored in high-density racking 20 metres high and collection items are retrieved by robotic cranes, which transfer stacks of newspapers via an airlock to a retrieval area where staff can remove requested items and send them either to the British Library Newsroom at St Pancras or the on-site Reading Room at Boston Spa (British Library, 2015).

We can see that this is an extremely tailored solution, which relies on an environment built specifically for the purposes of programmable robotic cranes. A similar crane-based system is in operation at the Sydney University of Technology, with the key difference being that this one also includes the ability to read RFID tags rather than just relying on items being in fixed locations (DeAizpura, 2016). Again this brings us back to Floridi's idea of the 'infosphere', whereby it is not necessarily that machines are becoming 'smarter' that we are using them more, but also that we are increasingly creating an environment in which they can operate.

In terms of public perceptions of ASRSs, Payne (2007, 14) observes that although these systems operate in a closed environment, they '…are attempting to match the user's experience in a traditional open-stacks library environment by providing requested items in about the same time as patrons would normally spend retrieving volumes from traditional library shelves.' She also addresses the potential impacts ASRSs may have on library staffing levels, interestingly pointing out that although the systems automate the process of retrieving and returning items to and from their locations, staff are still required to collect the requests and process them for users (Payne, 2007, 14). This could potentially change in future as these systems become more advanced and are able to automate more of the steps. Mogali (2014) even discusses the ongoing development of a Comprehensive Access to Printed Material (CAPM) robotic system, which would not only be able to retrieve physical items from a storage system when requested remotely, but also proceed to automatically scan items and use Optical Character Recognition (OCR) to index them and allow for full-text searching and analysis.

The previous examples of robots in libraries are all based on purpose-built storage spaces, rather than out in the open shelves, where there is arguably also a call for further automation. Blakemore (2016) writes that the process of ensuring that items have been properly shelved '…is time-consuming and never ending, as materials are continuously moved even if they don't circulate outside the building,' and O'Brien (2016) is even more passionate: 'The scourge of misplaced books remains one of the greatest death-by-a-thousand-cuts annoyances a library can suffer on a large scale.' As discussed, RFID has so far offered some solutions for this in the form of handheld scanners and smart-shelves, but these have not been broadly implemented due to the continued requirement for human effort, or their large cost. A new alternative that has been developed, which can navigate and scan library shelves to monitor books' locations, is the Autonomous Robotic Shelf Scanning (AuRoSS) system, developed on behalf of Singapore's National Library Board (Blakemore, 2016).

In a detailed report, AuRoSS's developers outline the technologies used, including RFID scanners, laser mapping technology, and robotic arms which can adjust their height to suit different book shelves (Li, Huang, Kurniawan & Ho, 2015). The wheeled robot has so far been tested at night when the library is closed, scanning all of the books and creating a report of any missing or misplaced books to be dealt with by human staff, with a reported accuracy rate of 99% (Li, Huang, Kurniawan & Ho, 2015). The remaining human element is crucial here, as the robot does not actually have the

capability to move books, and one of the developers is quoted by Blakemore (2016) as providing reassurance that 'The robot only performs the most menial and time-consuming part of the shelf reading operation,' which again supports the idea of 'symbiotic automation'.

Speaking about the implications of systems such as AuRoSS, O'Brien (2016) also provides the following reassurance: 'Now, I know what you're thinking: "Are robots on the verge of replacing human librarians?" Of course not. Librarians perform tasks far more specialized and complex than simple inventory control.' He lists several capabilities that are beyond AuRoSS that a human shelving assistant performs, such as dealing with stairs, shelving books, noticing books that have fallen off the shelf, and actually communicating with library users, and he is also cynical of its potential for widespread implementation: '…the cost and practicality of libraries' adopting similar technology will likely be outweighed for the foreseeable future by the ease of simply paying people an hourly wage to do manual labor in a quiet, climate-controlled space filled with books' (O'Brien, 2016). Whether or not systems such as AuRoSS will take off in coming years, it is interesting to consider the attention they receive from those with an interest in libraries, and the debates that emerge around which kinds of tasks people may want to be automated.

As well as tasks related to the circulation of physical stock, another important part of library work is monitoring the library space, and ensuring that the environment is safe and pleasant for users. For many libraries this role is not only carried out by frontline library staff, but also by dedicated security guards, and in recent years a robot named 'Bob' was the first to be tested in this capacity. Part of a bigger project aiming to develop robots that can 'act intelligently and independently in real-world environments', Bob also had a 'brother' called Werner designed to provide company for residents in an Austrian care home (Stacey, 2014). Developed at the University of Birmingham in collaboration with security firm G4S, Bob was equipped with the ability to monitor his surroundings to gather information such as whether desks are clear, where the busiest areas are, or if fire doors are open or shut, and the university library was seen as an ideal testing ground for this (Taylor, 2014; Yorke & White, 2014).

The humorous way that Bob was reported in the media at the time demonstrates some of the points previously raised about public perceptions of robots:

> His job is to ensure that desks and tables are kept clean and tidy, and he doesn't take kindly to messy students. He might not have the same capabilities as a cyborg Schwarzenegger, but he's definitely got a stare that will unsettle even the hardiest of perpetrators (Yorke & White, 2014).

Although tongue-in-cheek, this reference to a dystopian Sci-Fi vision of robots could reflect a potential worry that technologies like Bob can be seen as dangerous or threatening. However, reporting in a student newspaper, Taylor (2014) presents a positive user perspective of Bob, praising his ability to charge himself when his battery runs out, and claiming that the library would actually be an 'extremely safe environment' with Bob there to look out for any problems.

Regarding a potential threat to human employment, David Ella, Technology VP Product Marketing for G4S, stated that: 'The STRANDS project isn't going to produce a robot which can replace a human, but what it is going to do is support the security team by adding an additional patrolling resource. Our human security officers carry out a very wide range of different tasks, many requiring on-the-spot decision making and the ability to react to unpredictable fast changing events' (Stacey, 2014). As with AuRoSS, care is taken here by the developers of Bob not to create worries around the potential for human workers to be replaced, with an emphasis on his supporting role, and highlighting the areas where robots are arguably not yet capable.

We have seen with the examples of ASRSs, AuRoSS and Bob that library robots have already been in operation within real libraries. The next example is at the prototype stage, but has already been well reported and is worth considering due to the slightly different service it could offer when introduced. Developed by robotics students at Aberystwyth University, 'Hugh' has been described as an 'artificially intelligent library catalogue,' who 'will be able to take verbal book requests, work out where the hard copy is and lead students to the relevant bookshelf' (Saufenberg, 2016). As with AuRoSS, Hugh will rely on RFID technology to locate books but crucially will have the added capability of using speech recognition and natural language processing to interact directly with users, arguably going even further to replicate the roles carried out by human library staff.

As mentioned, Hugh is still at the prototype stage, and not yet in operation within the library, so we do not have the same evidence regarding his success or otherwise as we do for the other examples. However, it is again interesting to consider the response the project has received with regard to the potential for library work to be automated, and Hugh has already appeared in considerations of whether 'artificially intelligent machines eliminate library jobs' (Bell, 2016). Again we see the need for reassurance around such developments, and Saufenberg (2016) reports that '…the "world-first" prototype had so far been received well by faculty members' and that library staff were looking forward to working with the developers.

Bell (2016) points out that the use of the term 'librarian' in reporting of Hugh is not appropriate, as his functionality is limited to a very small part of what librarians actually do, but he does admit that 'a robot library clerk could potentially replace stack or circulation or workers.' This idea of the semantics around how robots entering human work environments are described is an interesting one, and is taken even further by a commenter on the Saufenberg (2016) article:

> #1 Submitted by philipbradley_276534 on February 28, 2016 - 12:07am
> *Well, let's see. Can it search a database? No. Can it recommend a database to an enquirer? No. Can it provide advice to an enquirer? No. Can it provide a list of useful, authoritative and validated resources? No. Can it help an enquirer get a new job, learn a new skill, understand a subject better or indeed do any of the other 101 things that a librarian does? Well, no. So in actual fact *it's not a robot librarian* then is it? Its as close to being a librarian as a shelf stacker is to managing the supermarket. In future less hyperbole and more accurate reporting please.*

The reporting around robots such as Hugh raises interesting points about the way that robots are described, and how people can feel threatened or angered by this. This again relates to the aforementioned ideas about the potential acceptability of new technologies not being solely related to their technological feasibility.

As well as the physical library robots discussed, there have also been experiments with online chatbots in libraries. One which was quite widely reported is Xiaotu, developed at Tsinghua University Library in Beijing and described as 'an artificial intelligence (AI) talking robot…which plays the role of a librarian in different locations on different terminals simultaneously and attracts users to participate in the resources collection in an intelligent and highly interactive manner' (Yao, Zhang & Chen, 2015, 245). The development of Xiaotu was based on the aforementioned ALICE chatbot, with the open source software allowing modifications to be made such as natural language processing in Chinese, and tailored corpora of knowledge relevant to the library service in question (Yao, Zhang & Chen, 2015, 249).

In their highly detailed report on the success of Xiaotu so far, Yao, Zhang & Chen (2015) outline her functions in the following order:

> …first, natural language communication in Chinese; second, expert answers in professional fields, particularly related to Tsinghua University professors and the library; third, book searching in the OPAC system; fourth, searching in Baidu Baike, China's version of Wikipedia;

> fifth, self-training and learning; and finally, interface to integrate with other systems.' (Yao, Zhang & Chen, 2015, 249)

As with the examples of digital assistants discussed previously, Xiaotu's natural language communication can be achieved through speech or text, and this is designed to be reinforced by her ability to learn from users where her knowledge is lacking. Although an important technological advance, the opportunity for people to teach chatbots how to respond to questions can lead to inappropriate content. This happened with Xiaotu and was reported in the *Daily Mail: '*a typically smutty response has been given to the question 'Can I touch you, Xiaotu' to which the intelligent computer replies 'Sure, but there's 20 Yuan extra charge'' (Baker, 2012). More recently Microsoft ran into similar trouble with their Twitterbot 'Tay', which began to independently repeat offensive tweets it had seen, so we can see this was not an isolated incident and again opens up the debate around how 'intelligent' these technologies actually are (Floridi, 2016).

Yao, Zhang and Chen (2015) not only describe the development and implementation of Xiaotu, but also discuss the research they have done to gauge people's reactions to her, including a user survey with students, and interviews with information science graduates and library staff. The questionnaire received a relatively small response (25 respondents) so the results are arguably not representative, but the general feedback seemed to be that Xiaotu was an interesting tool, but in need of improvement in several areas such as her knowledge base, and her tendency to provide meaningless information (Yao, Zhang & Chen, 2015, 254). The accompanying interviews are reported to have found that patrons see AI as 'mysterious, highly technical, and attractive,' and '…that Xiaotu was clever and answered the questions in a more interesting manner rather than rigidly and inflexibly' (Yao, Zhang & Chen, 2015, 255). The authors report that the library staff interviewed were positive about the adoption of AI technologies into virtual reference services, and as we have seen previously there is a reassurance that 'Librarians do not have to worry that Xiaotu may possibly replace them' (Yao, Zhang & Chen, 2015, 255).

Based on the user feedback, and their own observations, the improvements suggested by Yao, Zhang & Chen (2015) include further efforts to stop Xiaotu using inappropriate language, increasing the 'quality level' of her intelligence by adding new corpora and possibly using web crawlers, expanding her usage across other institutes, and co-operating with other departments of the university outside the library to reach a wider audience. It is clear from this particular experiment with a chatbot in a library that there are many considerations that need to be made before implementing such technologies, and there are still limitations to the technology, but also that people were generally receptive to the idea of this kind of technology by libraries and could see the potential advantages.

As well as robots being introduced in libraries to help carry out roles traditionally done by human library staff, such as shelving, monitoring library spaces, locating books, and answering enquiries from users, they have also been used for less traditional purposes. A widely reported case of this was in a Public Library in Westport, Connecticut, where two 'fully-automated, walking, talking robots' named 'Vincent' and 'Nancy' were brought in with the initial goal of teaching computer programming skills to library users (Kellogg, 2014). Waldman (2014) points out that other public libraries had already been offering training in programming or robotics, with the example of Chicago Public Library working with Google to give patrons access to 500 basic 'Finch' robots, but this was the first time in the USA that 'sophisticated humanoid bots' had been used.

Despite the initial focus on providing additional services to those offered by existing library staff, there is also the suggestion from the library worker responsible for them that Vincent and Nancy could be used for "practical stuff" as well, such as helping patrons locate books or greeting elementary-school groups that visit the library' (Waldman, 2014). This again raises important

questions about the true motivations behind introducing such technologies, and whether they may eventually lead to fewer jobs for human library staff.

With all of the examples of library robots given here it can be argued that they are not yet at the point where they can completely replace human workers in libraries. There seem to be consistent reassurances that they are intended to free up workers from mundane and repetitive work and provide assistance, so that human staff are able to do more interesting things and devote more time to helping library users, echoing some of the sentiment around RFID and computerised library systems. While this may be the case for now, it is important to recognise people's concerns and to consider some predictions for the future of library work.

2.2.4. Predictions for the future of library work

Returning to Raitt's 1985 article, it is interesting to see what was predicted for the 'library of the future' at that point, with ideas about robots reshelving items, speech activated computers, and the growth of digital information, that are relatively close to the developments we have seen in recent years. He also raises an early version of the ongoing debate around whether the internet could make libraries obsolete as '…some technologically-aware people can bypass the library and go direct to sources and online hosts themselves' (Raitt, 1985, 287). However, Raitt (1985, 287) is confident that librarians will still have a vital role to play in information literacy provision, searching unfamiliar and specialist sources for users, analysing and synthesising results, and advising on the creation, indexing, storage, retrieval and display of new knowledge. He ends with an optimistic prediction that 'the library will become a focal point of the community since all sources of information and all knowledge and much experience (in the form of expert systems) can be found there' (Raitt, 1985, 287).

Another set of predictions was made in 1996 in a study by the Swedish National Library, which describes the potential for 'robotic butlers' that would help users to locate material by fetching it from 'subterranean archives', and databases which can connect to people's kitchen devices at home to help them cook, as things that would be common in research libraries by 2045 (Hjerpe, 2016). Again we can see some truth in these predictions, even though we have not yet reached the stated year of 2045, with the growth of ASRSs and the Internet of Things demonstrating the potential for 'butlers' and the connected devices. The study also made short-term predictions for the year 2000, such as the idea that the process of borrowing would be fully automated, with publishers loading all required data on to books' integrated chips, and we can see that this is accurate in terms of the rise of RFID and self-service, but also that the potential of this technology has arguably not been maximised (Hjerpe, 2016). While acknowledging the many changes that could be brought about by technical change and increased automation, like Raitt's (1985) piece this study is optimistic about the future of libraries and the ongoing need for human library staff (Hjerpe, 2016).

More recent predictions have also been made, with similar themes re-emerging such as the predicted impact of increasingly digital collections and the ongoing rise of the internet. Payne (2007, 22) writes that '…academic institutions are questioning whether their already low-use print collections will be made obsolete by more flexible and accessible digital book collections,' and Lewis (2016, 87) argues that even if there is not a complete transition to digital resources, '…the market can now provide many of the documents and answers that matter most to people; it can do many of the jobs people need doing that in the past only a library could do. Everything does not have to be on the Internet to threaten libraries.' There is an ongoing argument here that there is not only a need to consider the potential impacts of increased automation of traditional library roles, but also

that the very existence of libraries (and by definition the jobs of the people who work in them) is under threat due to external technological advances (Lewis, 2016).

The broader debates around whether increased automation will be beneficial for human workers have been acknowledged in a library context, for example by DeAizpura (2016): 'Of course, there is always a fear that robots like these will mean less jobs in libraries…however perhaps these technologies will simply mean that the role of the information professional is evolving, and our focus will be on more complex tasks rather than circulation duties and the like.' DeAizpura (2016) also uses the familiar argument that the increased use of robots and AI will actually create jobs in libraries, as people will be needed to repair them when they malfunction, and to '…help people to connect or to think deeply about the information which these systems access' and provide a 'human touch'.

Others such as Bell (2016) refer to the increasingly accepted idea that jobs once seen as safe from automation due to their non-routine and complex nature could become increasingly less so, including in libraries. He argues that the human skills of empathy and creativity should give people an advantage for now, but if technology continues to advance then library workers may only be safe for the next ten to 15 years before they 'get roboted'. Lewis (2016) echoes this prediction, with the idea that smart machines will rely on human expertise to begin with, but will gradually move beyond this, and he draws a parallel with what has already happened to traditional reference work in libraries, arguing that other domains of professional library work can expect to see similarly huge changes brought about by new types of automation.

Lewis (2016, 150) emphasises the need for academic library workers to identify the unique roles they are able to fill, and to make the most of the potential benefits that can be brought about by developments in AI, stating that '…the trick will be to work with and not against the smart machine and to deepen relationships – particularly with faculty at the job of making teaching, learning, and research more effective.' Mirando (2016) makes similar points in his advice for law librarians, advising them to prepare for the future by acquiring the necessary skills that will stand them apart from those possessed by AI, and '…by working with and not against the inevitable changes.' It is clear that automation, whether through physical robotics or online AI, is not the only factor in considering the future of library work, but it is certainly one of the biggest, and that is why there should be a debate about how and where this will be done.

3. Research Methods

For the original research carried out a mixed methods approach was implemented, which included an online questionnaire and a focus group. This approach was taken to provide a mixture of quantitative and qualitative data, which could then be used to tackle the objective: 'To gauge perceptions of AI/robots in a Library context and establish which areas of library services users/workers may be more comfortable 'handing over' to AI/robots.'

3.1. Survey

An online questionnaire was chosen for the survey part of the research, as it was thought that this would offer the best potential to reach a target of 100-150 participants. It should be acknowledged that there are limitations to online surveys, as pointed out by Bawden & Robinson (2012): '…all that can be known is those who replied to it; the number who saw it, and did not respond, cannot usually be established, nor can whether there is anything different about those who responded and those who did not.' Pickard (2013) also points out issues: 'Another problem is the technology itself; different browsers mean it can be difficult to be totally sure of how your questionnaire will appear to everyone who opens it.' However, it was felt that for the purposes of this research, the use of a carefully designed online questionnaire was appropriate and would provide valuable data, especially when combined with a focus group.

The online tool eSurvey Creator was used to create this questionnaire, as a free student-trial was offered, and the author had previously seen this software used for similar library and information related surveys. Alongside original questions written by the author, the aforementioned European Commission (2012; 2015) surveys were used as a framework for several parts of the questionnaire, with modifications made to reflect the library-focused nature of this research. This replication of a previous survey is supported by Urquhart (2013, 138): 'Before setting out to design a questionnaire, it's worth checking whether anyone else has done a similar study. There is no point in making extra work for yourself, if other groups have already done the hard work of developing and testing a questionnaire.' It was felt that using a similar format to the European Commission surveys would allow a good basis for comparisons, and for drawing broader conclusions, while also being aware of the smaller scope and predicted sample size of the questionnaire in question.

Respondents were required to provide an answer to all multiple-choice questions in order to continue to the following step of the questionnaire, to ensure that a complete data-set was obtained. It was not seen as necessary to make the questions requiring free-text responses compulsory as they were intended to provide additional qualitative data, and respondents may have felt pressurised to provide an answer that they did not want to. Routing was also used for certain responses to avoid asking respondents irrelevant questions, for example where they said they had never used a library, or were not currently working in a library. Following the guidance of Pickard (2013, 210) the questionnaire was designed to have 'unthreatening, friendly questions first' and left '…questions that require your respondent to express a view or an opinion until at least a third of the way through the questionnaire.'

The first section of the questionnaire was intended to establish the frequency and nature of respondents' library use, and their awareness and attitudes towards self-service and RFID. In a similar way to the first European Commission (2012) survey, with its initial questions on respondents' general awareness of technology, this was intended to get respondents thinking about

the types of automation that are already in place in libraries, and to provide variables for comparisons with the later questions about robots. A particularly important question that was designed to be used for that purpose was the one asking if respondents would prefer to borrow/return library items through a member of staff, or by using a self-service machine, as it was felt that this could potentially be correlated with acceptance of other forms of automation in libraries.

The next section of the questionnaire, which would be routed to straightaway by anybody who said they had never used a library in the first question, was designed to gauge respondents' general attitudes towards robots. A free-text response was requested in the first question, asking respondents to come up with five words or phrases they associate with the term 'robot'. It was felt that this was a good chance to acquire some limited qualitative data that could be coded for analysis, and would give respondents the chance to express their own ideas about what a robot is, before being influenced by the definition and examples that would follow.

The following questions were lifted directly from the European Commission (2012; 2015) surveys, using the same definition of a robot they used, but with an added sentence (underlined) tailored for this particular questionnaire:

> *A robot is defined as a machine which can assist humans in everyday tasks without constant guidance or instruction, e.g. as a kind of co-worker helping on the factory floor or as a robot cleaner, or in activities which may be dangerous for humans, like search and rescue in disasters. Robots can come in many shapes or sizes and some may be of human appearance. Traditional kitchen appliances, such as a blender or a coffee maker, are not considered as robots. Similarly self-service machines in supermarkets or libraries are also not considered as robots.*

It was felt that providing a clear definition of what a robot is, with an added condition relevant to libraries, was important as it would help to mitigate confusion and give respondents a consistent concept for answering the questions that followed.

Following a question intended to find out whether respondents had ever used a robot, again a potentially important variable for evaluating respondents' attitudes, there were several scaled questions to gauge respondents'' general views on robots, including whether they had a positive or negative view of them, if they think their current job could be done by them in future, and their levels of agreement with statements such as 'Robots steal peoples' jobs' and 'Robots are necessary as they can do jobs that are too hard or too dangerous for people.' Pickard (2013) points out that scaled questions are useful as they are easy to code due to their greater uniformity of response, but also notes that they may lead to respondents answering inappropriately if their use is not seen as justified. It was felt for this questionnaire that these questions and their scales had already been tried and tested in the European Commission (2012; 2015) surveys and had given useful results, so it was acceptable to follow the same format again.

The next section was influenced by the European Commission (2012; 2015) surveys, but again modified for the library context. The previous surveys had attempted to gauge respondents' comfort levels with different uses of robots, something which was also done in the British Science Association (2015) survey, so it was felt that a similar question could be asked relating to some of the library robots discussed in the literature review above. It was decided that some general descriptions, based on Automatic Storage and Retrieval Systems and robots such as AuRoSS, Bob, Hugh and Xiaotu but not explicitly mentioning them, would be given, and respondents would be asked to rate how they would feel about their potential use in libraries for certain roles. Again the scale used was the same as the one in the corresponding European Commission (2012; 2015) question, to enable

easy coding and comparisons. A question was then included asking respondents if they had any other ideas for uses of robots in libraries, designed to gauge peoples' general awareness of existing examples of robots and also their general attitudes towards their use.

Perhaps most important for the purposes of this study was a question asking what impact respondents thought '…the use of robots for roles traditionally carried out by human library staff would have on the services provided for library users,' which again used a positivity/negativity scale, and was followed by a free-text question asking why respondents felt that way. It was felt that the combination of these two questions could provide some very interesting results and data on people's current perceptions of automation in libraries and predictions for the future, and could be compared with earlier responses on their general views on robots and acceptance of specific uses.

There were several questions to establish the demographics of the sample included at the end of the survey, with a key one being whether or not respondents were currently working in a library and what type, as well as questions on age, gender and country of residence. It was important to find out whether respondents were working in libraries as this was intended to form one of the main variables when analysing the results, and also as a precursor to the focus group which would consist wholly of library workers.

Pickard (2013) points out the importance of piloting questionnaires before launching them fully, and this was done with friends and family, leading to some alterations in the order of questions and their wording. It was also important to test the questionnaire on different devices and browsers to ensure it worked properly, in line with Pickard's (2013) earlier observation. The questionnaire was targeted at anybody aged 18 or over, and was distributed through social media and email (see appendices for tweet, Facebook post, and email to colleagues). After the questionnaire was closed the raw data was analysed using eSurvey's online platform, as well as Excel.

Ethical approval was not required to carry out this questionnaire as it was not targeted at young or vulnerable people, and it did not include any potentially inappropriate or offensive content. Also, it was made clear in the introductory page what the basic aim of the research was and that responses would be anonymous, as well as contact details being provided for the author on the end page in case respondents had any comments or questions.

Sample

Although the survey was designed to gauge attitudes towards the potential use of robots and AI in libraries, people who do not use or work in libraries were also welcome to respond. In reality there were only two respondents out of 165 who said they had never used a library, so the great majority of respondents had used a library at least once. Out of 165 respondents who completed the survey, there were 100 (60.6%) who identified as female, 59 (35.8%) as male, 2 (1.2%) who preferred to self-identify, and 4 (2.4%) who preferred not to say. Thus we can see that the sample was slightly skewed towards females. In the age categories there were 0 respondents in the 17 or younger and 18-20 categories, 60 (36.4%) aged 21-29, 46 (27.9%) aged 30-39, 16 (9.7%) aged 40-49, 20 (12.1%) aged 50-59, 19 (11.5%) aged 60 or older and 4 (2.4%) who preferred not to say. The sample was therefore predominantly made up of people aged under 40.

Although there were not enough responses from outside the United Kingdom to draw any meaningful geographical comparisons, it is interesting to note the range of countries that were listed. In terms of current country of residence 143 (86.7%) respondents answered United Kingdom and 22 (13.3%) answered 'other', with the majority living in the USA, New Zealand and Australia, but

there were also single responses from Hungary, the Republic of Congo, Jordan, Cambodia, Jamaica, Guyana, Japan and Spain.

41 respondents (24.8%) said they were currently working in libraries, and 124 (75.2%) said they were not. Of the 41 library workers, 80.5% (33) worked in Academic/research libraries, 7.3% (3) in School libraries, 4.9% (2) in Public libraries, 4.9% (2) in Law libraries, and 2.4% (1) in a Business library. We can see that there was certainly a disproportionate percentage of library workers in this sample compared to what would be found in the general population. This was to be expected considering the nature of the recruitment for the survey, and in the analysis of the data there will be distinctions made between the responses of those who work in libraries and those who do not.

As outlined by Bawden & Robinson (2012) the small scale of this kind of survey meant it was not necessary '…to adopt the rigorous methods of sampling and analysis used for purposes such as public opinion polling or large-scale market research,' so it should be acknowledged that the sample achieved cannot be seen as representative of the population as a whole.

3.2. Focus Group

As discussed the additional use of a Focus Group as well as an online questionnaire was chosen to provide more in-depth qualitative data and to follow up on issues raised by the initial survey, as described by Stewart & Shamdasani (2015, 44): '...focus groups have also proved useful following the analysis of a large-scale quantitative survey…the focus group facilitates interpretation of quantitative results and adds depth to the responses obtained in the more structured survey.' Because of this intended connection between the questionnaire and the focus group, it was felt to be important that the participants for the group should have already completed the questionnaire so they would already be aware of the context of the research, and could draw on their previous responses and thought processes. When a satisfactory response rate had been reached it was decided to close the online questionnaire and start planning and recruitment for the Focus Group.

In terms of planning for the group, a discussion guide was created (see appendix) by the author, who would be planning and moderating a focus group for the first time. Although some commentators in the literature such as Pickard (2013, 248) would suggest that focus groups are a particularly difficult method of research for people who have not done them before, she also describes them as '…a more useful method of harvesting in-depth data from a wide range of participants than any other technique available.' It was felt that the focus group would be a key tool alongside the online questionnaire, and could be successfully carried out with careful preparation. In a similar way to the questionnaire the discussion guide was broken down into sections, which aimed to find out about participants' experiences of technological changes in libraries, their general attitudes towards robots, their comfort levels with specific examples of library robots and finally their thoughts about the future of libraries. The guide included general headings, with approximate timings to help the group run on schedule, and a series of questions and potential probes to be used, with the recognition that 'probes are a critical part of extracting information in focus groups' (Stewart & Shamdasani, 2015, 106).

A set of slides in PowerPoint (see appendix) was created to be used by the moderator during the focus group, to provide visual accompaniments for participants and to show photographs of the real-life examples of library robots being referred to. There was also a group activity, which involved printed out written examples of the same library robots used in the questionnaire (see appendix),

with participants being asked to work in groups to order them from 'most comfortable' to 'least comfortable'. The advice of authors in the research literature was followed in choosing the order and nature of the questions, and in deciding to use a group activity as a way to '…increase the interest level of participants while also providing vehicles for expressions of opinions in ways other than simply talking' (Stewart & Shamdasani, 2015, 100).

Based on the response rate for a question asking whether questionnaire participants who were working in libraries were willing to take part in some further research, a decision was made to limit recruitment to staff at the UCL Institute of Education (IoE) Library, where the author currently works. The research methods literature would seem to suggest that although traditional focus groups were held with participants who did not already know each other as this provided a level of anonymity and encouraged candour, it has more recently become accepted that groups held amongst members of existing social units, such as co-workers, have the advantage of people holding a 'shared language', and can provide particularly useful insights (Carey & Asbury, 2012; Stewart & Shamdasani, 2015) In the case of this study, it was thought that recruiting a group of colleagues would allow for a concentrated approach, and that the author could draw on personal experience and in-depth knowledge of the specific situation at the IoE Library in relation to the adoption of new technology and the potential for automation.

Recruitment was carried out through internal emails (see appendix), with an intended response rate of 5-10 participants, as is recommended by authors such as Carey & Asbury (2012,45), who write that they find '…groups larger than seven or eight a bit large and harder to manage.' A choice of two dates was offered on the condition that the most popular date would be chosen, and it was made clear that the group would start just after work (17.15) and would last no longer than an hour. As the group was to be carried out with members of IoE Library staff the location for the group was chosen as one of the bookable rooms within the library to reduce any inconvenience to participants. Also it was made clear that refreshments would be provided, as recommended by authors such as Krueger (1997). A total of 7 colleagues volunteered to take part in the focus group, with a majority of 5 saying they could attend on one of the days so that day was chosen.

The materials and preparation required for the focus group included: the aforementioned discussion guide, print-outs for the group activity, a PC and projector to display the slides, a dictaphone to record the discussion, a table and chairs, and refreshments. Participants were asked to arrive a few minutes before the scheduled start-time to ensure they could make themselves comfortable and help themselves to refreshments before the group began. An introduction was given to explain the purpose of the research, referring back to the questionnaire that all participants had already completed, and to explain that the discussion was being recorded, but that participants' names would not be included in the transcription that would follow. It was also made clear that all opinions were considered valid, and that the author was particularly looking for their views as library staff, not as experts on robots.

To start the discussion, and to help make all participants feel comfortable with talking, they were asked to introduce themselves and explain their job role. Following this it was not made compulsory for all participants to provide a response to each question, as this could have a negative effect on the spontaneity and natural flow of the conversation, but an attempt was made to ensure that everybody had the chance to talk and that the conversation was not dominated by one or two individuals, through the use of careful prompting and body language. Also, following the advice of authors such as Krueger (1997), care was taken as the moderator of the group to guide the discussion, but not to actively engage in the discussion or share personal views, as this could

introduce an unnecessary bias into the results of the group and prevent an accurate version of the participants' views being shared.

After the group was completed a transcript was created (see appendix) by the author using the recording. Although it is recognised that a transcript of a focus group cannot fully represent everything that happened, for example missing any physical gestures or reactions that may have occurred, it was felt that full transcription was the best way to prepare for the thematic analysis that would follow (Carey & Asbury, 2012).

Sample

As explained the group of 5 participants was recruited exclusively from IoE Library staff, so the sample cannot be seen as representative of all libraries or all library workers. However, a good range of specialities and job roles was represented by those who took part, with the sample including a Head Librarian, a Library Assistant within Collection Development, a Cataloguing Librarian, an Issue Counter and Membership Desk Supervisor, and a Research Support and Special Collections Librarian. The group was made up of 3 women and 2 men.

4. Results

4.1. Survey

There were 188 respondents in total to the online questionnaire. However, for the purposes of this analysis, only the data of the 165 respondents who fully completed all compulsory parts of the questionnaire will be considered. The full list of questions and the responses for the total selected sample are located in Appendix A.

4.1.1. Library usage and views on self-service

98.8% (163) of the 165 respondents had used library services at some point, with 47.2% (78) describing themselves as current users and 51.6% (85) as past users. Out of the 163 who had used library services, 14.7% (24) had used a library that day, 17.8% (29) had used a library in the last week, 14.1% (23) had used a library in the last month, 20.2% (33) had used a library within the last year and 33.1% (54) had used a library longer than a year ago, as shown in Figure 3.

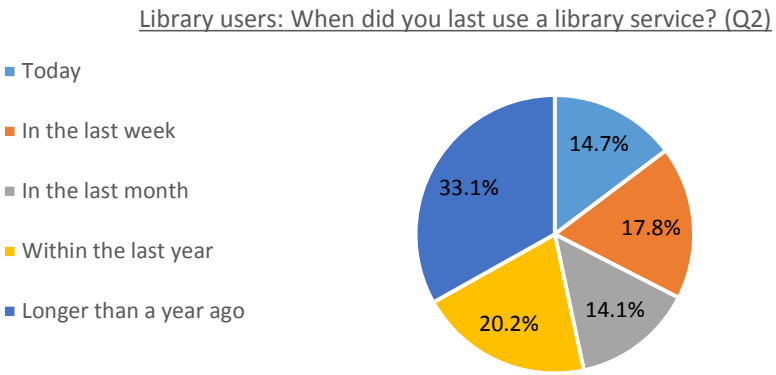

Figure 3

Of the 41 respondents (24.8% of total sample) who said they were currently working in a library, 87.8% (36) were also current library users, with 90.2% (37) having used a library within a month or more recently. Of the 122 respondents not working in a library who had used library services 32% (39) said they had used library services within the last month or more recently, as shown in Figure 4, and will be classified as 'recent library users'.

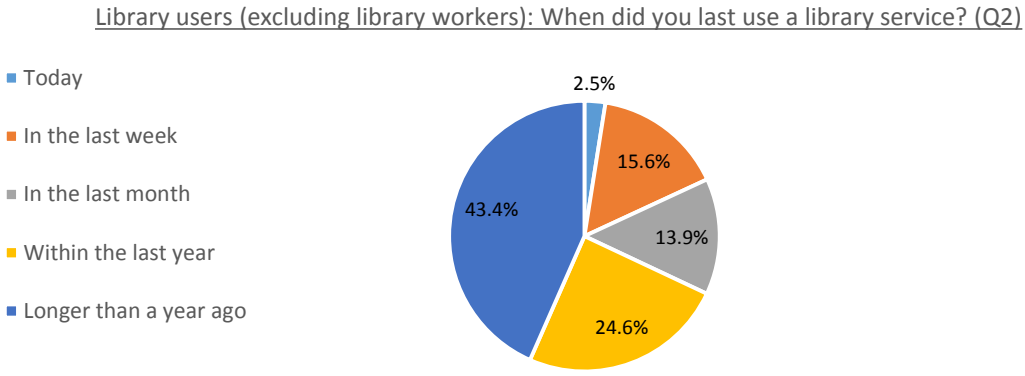

Figure 4

The type of library that the majority of respondents said they were most likely to use was Public, with 54% (88) of respondents, followed by Academic/research with 35% (57). Medical, School, and 'Other', were all selected by 3.1% (5), and 1.8 % (3) said Law. When asked which library services/resources they had made use of, the most popular responses involved using books/other items for borrowing and for reference use, with 94.5% (154) and 82.8% (135) of respondents saying they had done so, respectively.

A majority of respondents who had used a library said they had also used a self-service machine in a library, with 79.1% (129), compared to 20.9% (34) who said they had not. However, when asked whether they had used a library with RFID technology only 41.7% (68) said they had, with 20.2% (33) saying they had not, and 38% (62) saying they did not know, as shown in Figure 5.

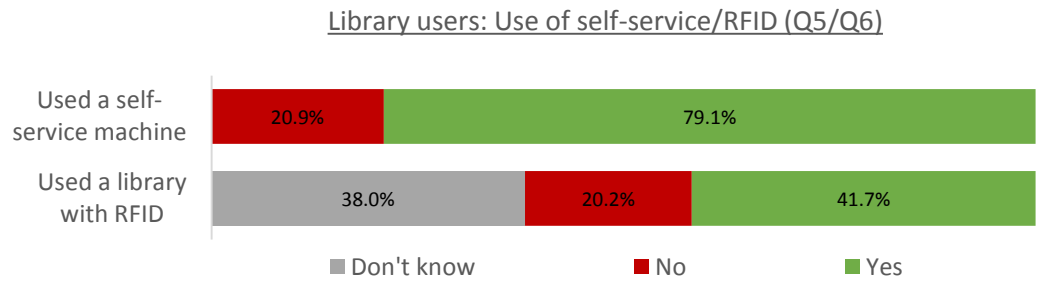

Figure 5

Of the 129 respondents who had used self-service, only 51.2% (66) said they had also used a library with RFID, 14.7% (19) said they had not, and 34.1% (44) were not sure. Library workers in the sample were much more likely to have used self-service (97.6%) and a library with RFID (85.4%) than the total sample.

When respondents were asked their preference for borrowing or returning library items the most common response with 42.9% (70) was 'no preference', followed by self-service machine with 31.3% (51), library staff with 25.2% (41), and 0.6% (1) said they did not know. For the 41 library workers in the sample the order of preference was the same, as 36.6% (15) said no preference, 34.1% (14) said self-service, and 29.3% (12) said library staff.

4.1.2 General views on robots

For the first question specifically concentrating on robots, respondents were asked to write down up to 5 words or phrases which came to mind. 162 respondents answered this question, with a total of 616 words and phrases given. The responses have been coded thematically, with the top results (5 or more mentions) shown in Figure 6 and also illustrated with the Word Cloud in Figure 7.

Code	Count
Automation	44
Machine	33
Future	19
Sci-fi	19
Artificial Intelligence	17
Metal	15
Impersonal	14
Terminator	13
Mechanical	12
Technology	12
Efficient	10
Non-human	10
Android	8
Asimov	7
Futuristic	7
Humanoid	7
Quick	7
Redundancy	7
Car manufacturing	6
Computer	6
Non-emotive	6
R2D2	6
Automaton	5
Drone	5
Inflexible	5
Unfriendly	5
Wars	5

Figure 6: Results from thematic coding of words or phrases associated with 'robot'

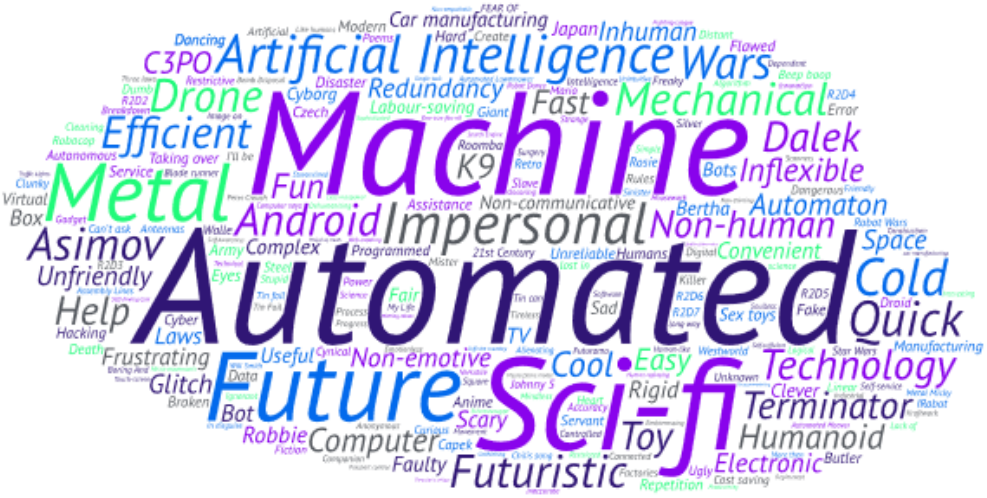

Figure 7: Word Cloud showing thematic coding

When asked if they had ever used a robot at home, at work, or elsewhere, 83% of respondents (137) said no, with 4.8% (8) saying they had at home, 6.7% (11) saying they had at work, 2 (1.2%) saying they had elsewhere, and 4.2% (7) saying they did not know. Out of the 41 library worker respondents, 80.5% (33) said they had not used a robot in any capacity.

Concerning their general attitudes towards robots 65.5% (108) of respondents reported a positive view of robots, with 11.5% (19) expressing a very positive view and 53.9% (89) fairly positive. 21.8% (36) said they had a fairly negative view, and only 0.6% (1) said very negative, with the remaining 12.1% (20) as 'don't know'. Of the library workers a slightly lower total proportion expressed positive views, with 48.6% (20) choosing fairly/very positive. A full comparison is shown in Figure 8.

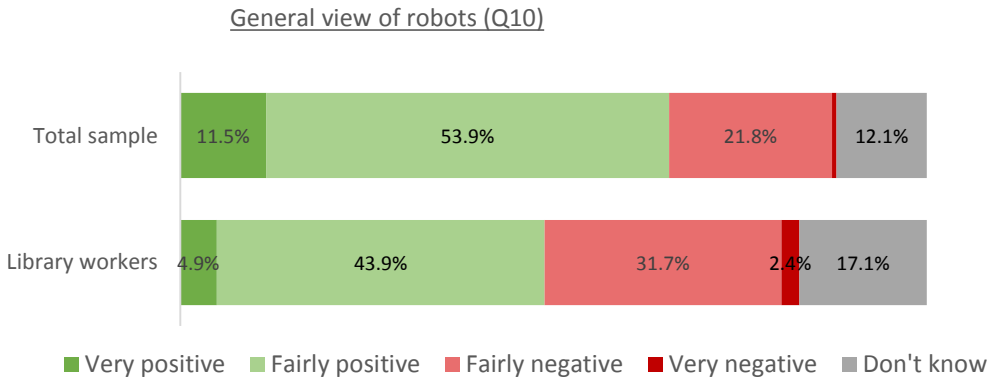

Figure 8

With regard to whether they thought their job could be done by a robot in future, 55.7% (92) of the total sample thought that could be done at least partially, with 35.2% (58) saying not at all, and 1.8% (3) who did not know. In the sample 7.3% (12) were not currently working. For library workers, a greater percentage thought that their job could be at least partially done by a robot in future (73.1%), with the full breakdown shown in Figure 9.

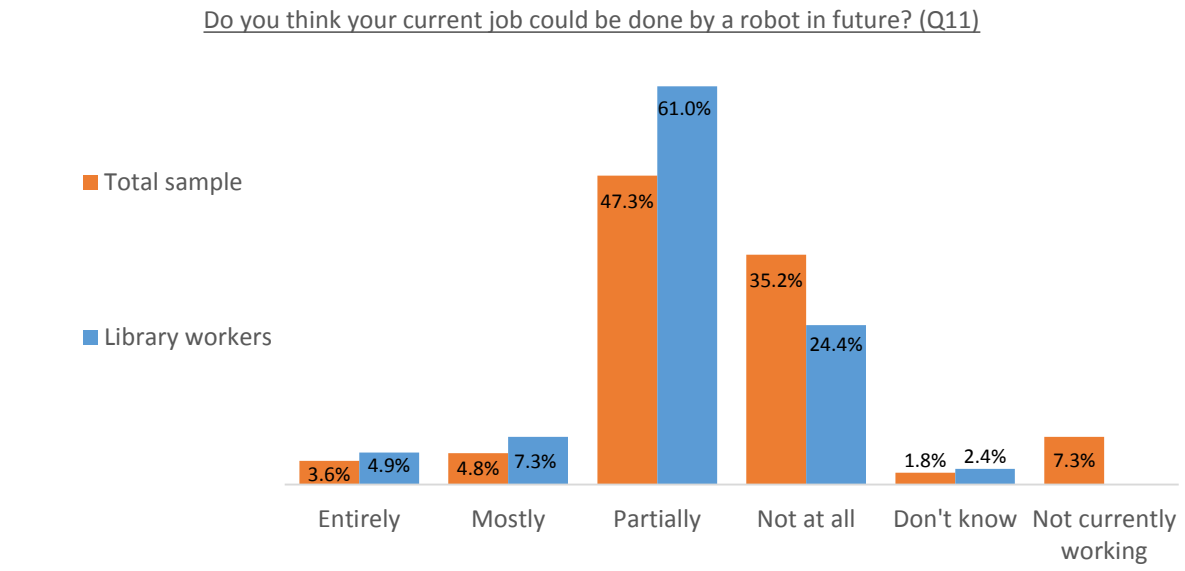

Figure 9

Respondents were asked how much they agreed with four statements about robots, with responses shown in Figure 10. The statement that got the highest level of agreement from the sample as a whole was that 'robots are a form of technology that requires careful management', with 95.2% (157) agreeing to some extent. Next was the statement that 'robots are necessary as they can do jobs that are too hard or dangerous for people' with 90.9% (150) agreeing, then 'robots are a good thing for society' with 79.4% (131), and finally 'robots steal people's jobs' with 50.9% (84).

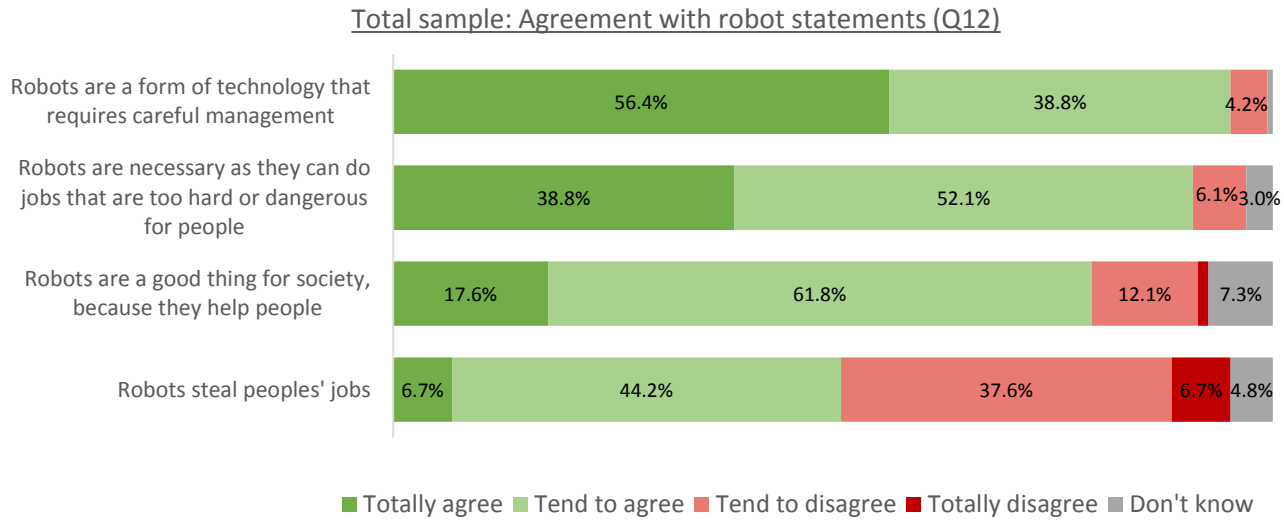

Figure 10

For library workers there was a similar order of agreement to the total sample as shown in Figure 11, although with a slightly higher percentage agreeing that robots are necessary for hard or dangerous jobs (92.7%), and slightly lower percentages agreeing that robots are a form of technology that requires careful management (92.7%), robots are a good thing for society (70.7%), and robots steal people's jobs (43.9%).

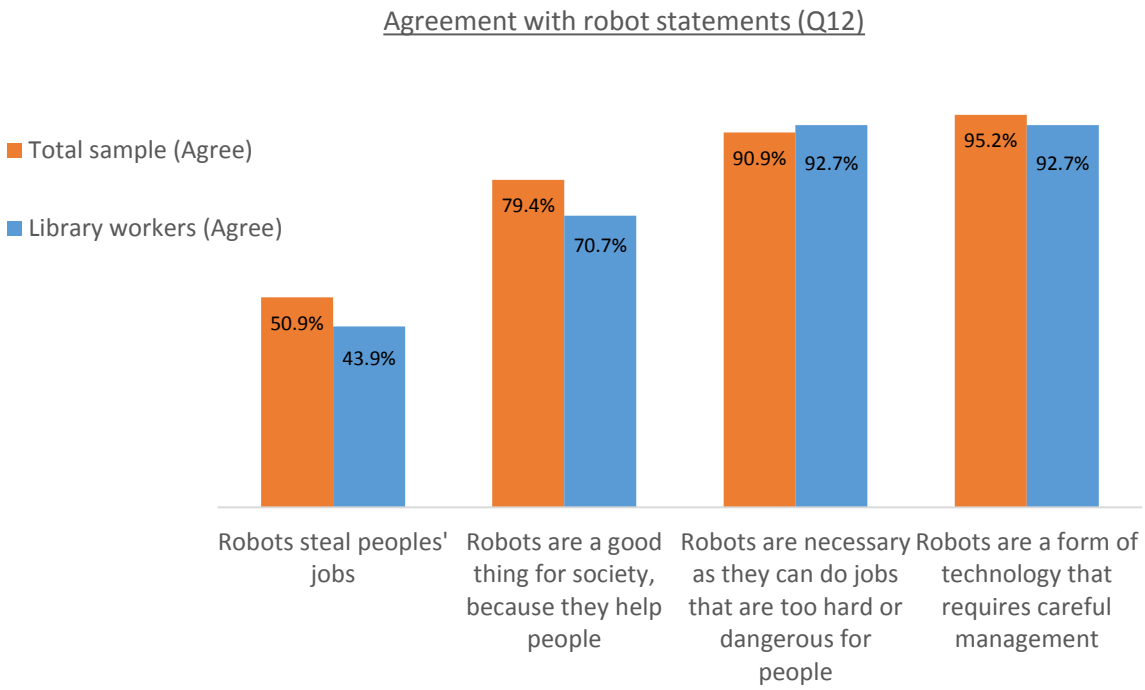
Agreement with robot statements (Q12)
Total sample (Agree)
Library workers (Agree)
50.9%
43.9%
79.4%
70.7%
90.9%
92.7%
95.2%
92.7%
Robots steal peoples' jobs
Robots are a good thing for society, because they help people
Robots are necessary as they can do jobs that are too hard or dangerous for people
Robots are a form of technology that requires careful management

Figure 11

4.1.3. Attitudes towards 'library robots'

When given five examples of roles that robots could potentially carry out in libraries, respondents felt most comfortable with the idea of a robot 'shelver', with 75.8% (125) saying they would be comfortable (a score of 7-10 on the scale). Second was the basic 'library chatbot', with 72.7% (120) comfortable. Third was the advanced chatbot, with 60% (99) comfortable. Fourth was the robot 'assistant', with 49.1% (81) comfortable. With the lowest levels of comfort was the robot 'security guard', with 24.8% (41) comfortable. As is depicted in Figure 12 the robot 'security guard' was the only one that a majority of the sample felt uncomfortable with.

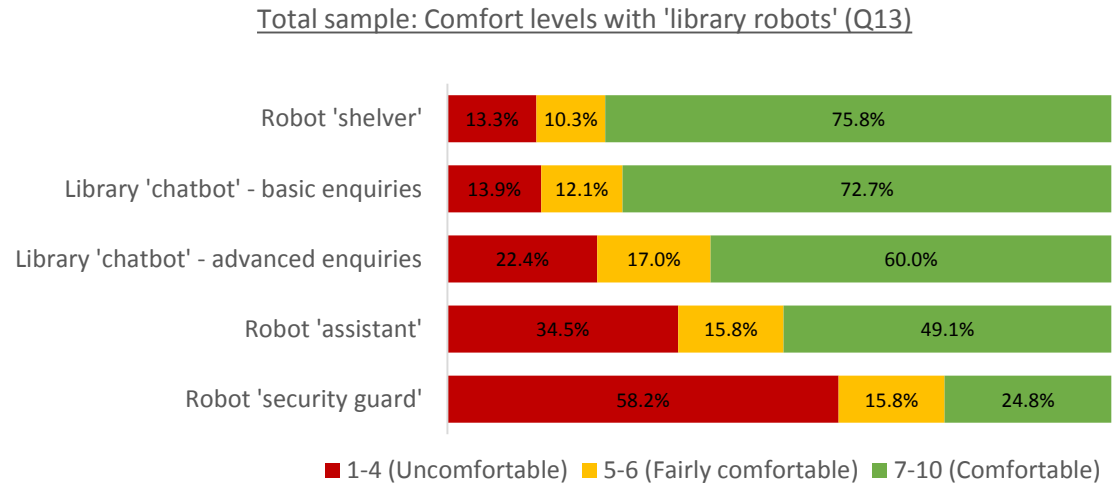

Figure 12

Overall the 41 library workers felt less comfortable about all of the examples given compared to the total sample, and the order of the robots was slightly different, as shown in Figure 13. 68.3% (28) would be comfortable with the robot 'shelver', 58.5% (24) comfortable with the basic chatbot, 43.9% (18) comfortable with the 'assistant', 39.1% (16) comfortable with the advanced chatbot, and 22% (9) comfortable with the 'security guard'.

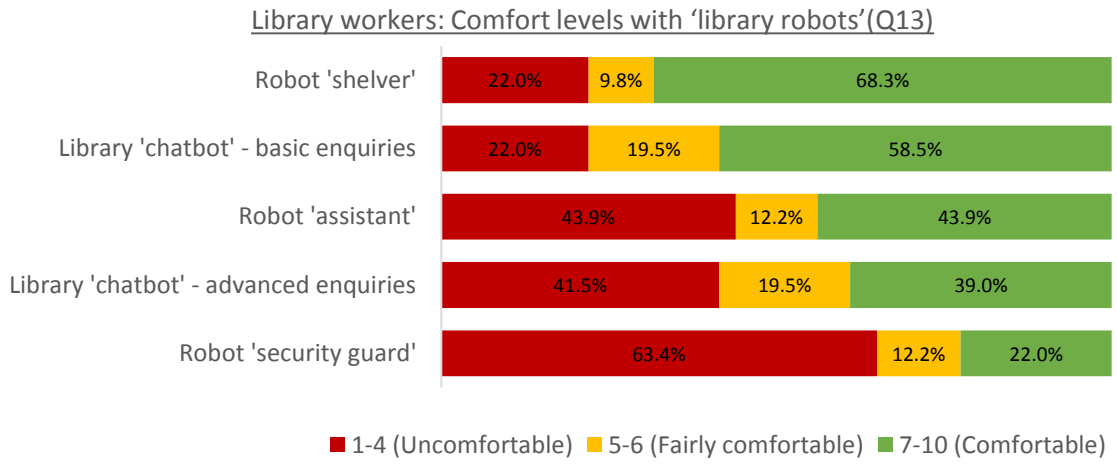

Figure 13

Of the 39 recent library users (the group excluding library workers), 69.2% (27) would feel comfortable with the idea of a robot ‘shelver’, 64.1% (25) would feel comfortable with the basic chatbot, 59% (23) would feel comfortable with the advanced chatbot, 48.7% (19) would feel comfortable with the ‘assistant’, and again in last place, 10.3% (4) would feel comfortable with the idea of the ‘security guard’, as shown in Figure 14. As with library staff the recent library users’ comfort levels were lower on average than the sample as a whole, particularly with the idea of a robot ‘security guard’.

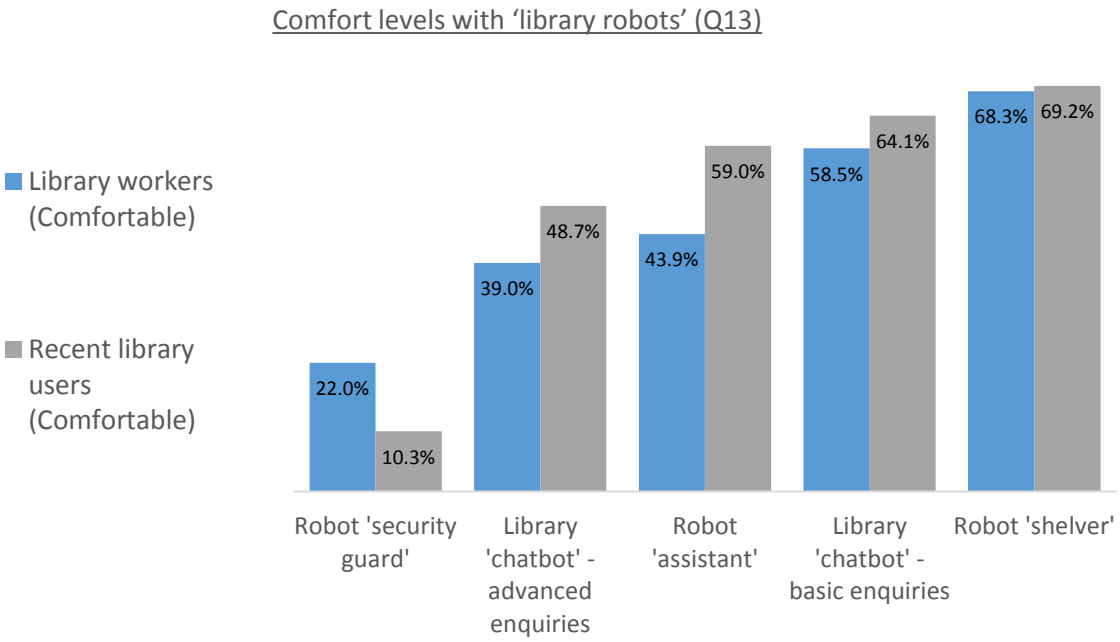

Figure 14

Referring back to the question about preference for using a self-service machine or library staff to borrow or return items, 31.3% (51) of the 163 respondents who had used a library chose self-service, and 25.2% (41) chose library staff. Of the 51 who chose self-service, 84.3% (43) said they would feel comfortable with the idea of the robot ‘shelver’, 68.6% (35) comfortable with the basic chatbot, 62.7% (32) comfortable with the advanced chatbot, 56.9% (29) comfortable with the ‘assistant’, and 31.4% (16) comfortable with the security guard.

Of the 41 respondents who chose library-staff as their preference, 65.9% (27) would feel comfortable with the basic chatbot, 61% (25) comfortable with the ‘shelver’, 48.8% (20) comfortable with the advanced chatbot, 31.7% (13) comfortable with the ‘assistant’, and 9.8% (4) comfortable with the ‘security guard’, the lowest comfort level of any of the groups analysed. A comparison of these two groups is shown in Figure 15.

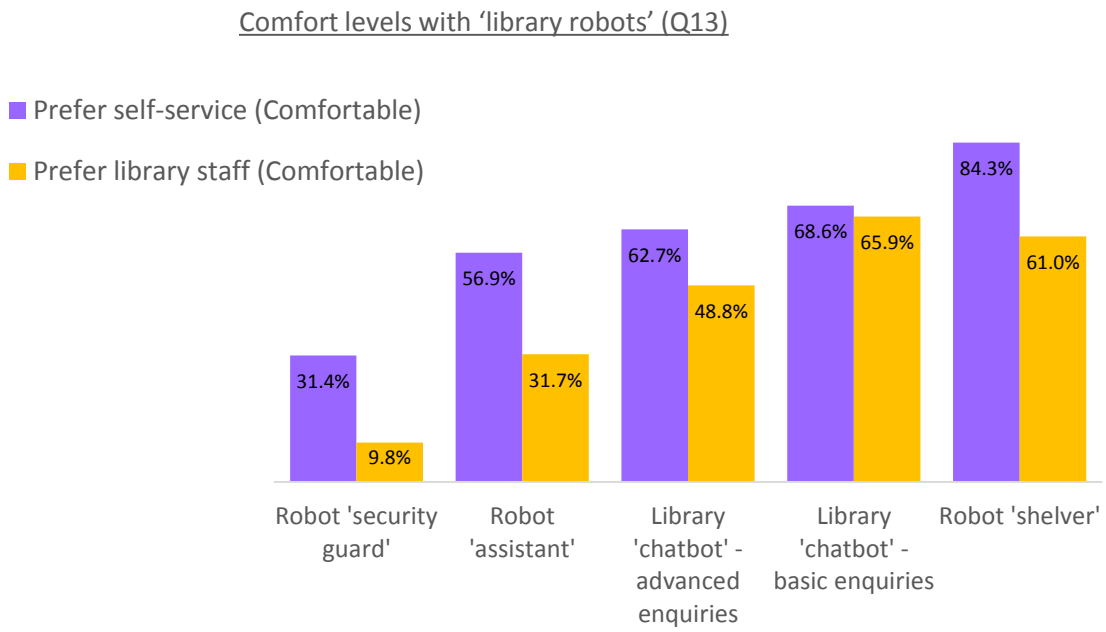

Figure 15

When asked to list any other uses for robots in libraries, 70 respondents gave an answer, with some giving simple one or two word ideas, and some giving very detailed descriptions of what they think library robots could be used for. Some of the most repeated ideas included carrying out tasks such as cleaning, finding lost books, sorting returned books, collecting items from storage, interacting children, helping users with disabilities, and AI being used for data analysis e.g. to make reading recommendations. Please see below for some selected quotes:

> *"It would be **helpful if a robot would make an announcement to be quiet** if the sound became too loud, instead of having to find a librarian to come tell other people in the library"*
>
> *"**Retrieving and returning from archive** like the robots used in the BRITISH Library newspaper archive"*
>
> *"Helping to **read stories** to children"*
>
> *"**Artificial intelligence assistance in finding and selecting articles**- like a Google Scholar version of Google's assistant"*
>
> *"I'm not entirely sure the library is the right place for a robot. A librarian is an iconic part of libraries and part of the experience. I can't imagine wanting a little robot buzzing around while I'm sifting through books. **Maybe they could help doing the cleaning**..."*
>
> *"**Gathering and crunching useful statistics** about user numbers and patterns to improve services. **Assisting people with disabilities** with physical operations. Being on hand to **recommend further resources** based on information about what a user is trying to find or do. **Monitoring hygiene and health and safety conditions**, such as temperature, and sending through alerts when problems occur or the environment is inhospitable."*

*"**Checking shelfmark ranges of bays** to feed into a shelfmap system and ensure the start and end ranges have not changed; **Using rfid tech with a robot** to record books in use within the library envelope for better collection management and space usage decision making"*

4.1.4. Predictions for the future

When asked what impact they thought the use of robots for roles traditionally carried out by human library staff would have, overall 42.4% predicted a positive impact, and 40% a negative impact, as shown in Figure 16. 3.6% (6) said very positive, 38.8% (64) said fairly positive, 30.9% (51) said fairly negative, 9.1% (15) said very negative, 2.4% (4) said no impact, and 15.2% (25) said they did not know.

Looking at the 41 library staff, overall 24.4% predicted a positive impact, and 48.7% a negative impact. 0% thought robots would have a very positive impact, 24.4% (10) fairly positive, 34.1% (14) fairly negative, 14.6% (6) very negative, 2.4% (1) no impact, and 24.4% (10) did not know. For the 39 recent library users (the group excluding library staff) a total of 33.4% predicted a positive impact, and 51.3% a negative impact. 2.6% (1) thought robots would have a very positive impact, 30.8% (12) fairly positive, 38.5% fairly negative (15), 12.8% (5) very negative, 0% no impact, and 15.4% (6) did not know.

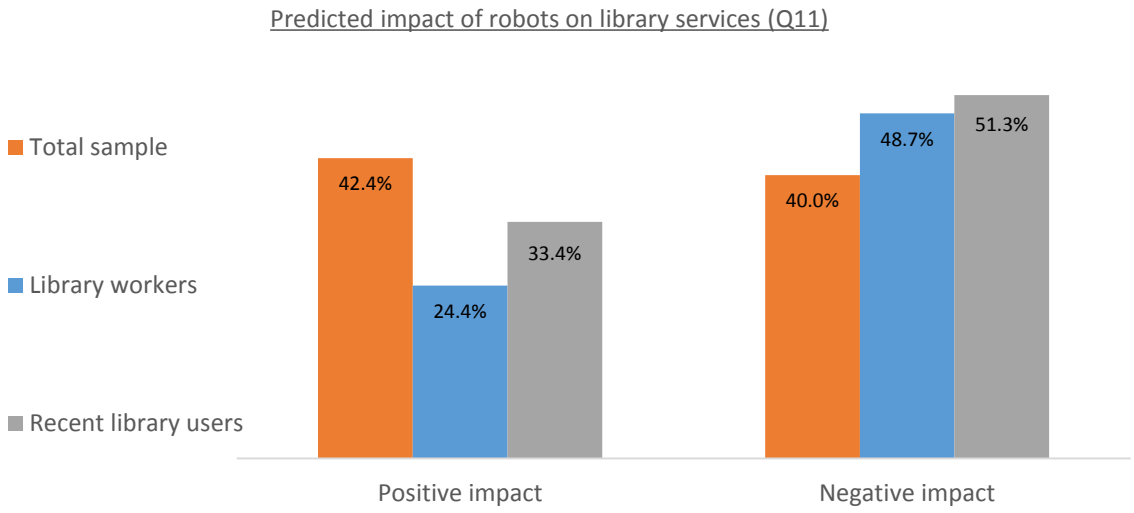

Figure 16

Of the 51 respondents who chose self-service as their preference when borrowing or returning items, 54.9% predicted a positive impact, and 27.5% a negative impact. 3.9% (2) thought robots would have a positive impact, 51% (26) fairly positive, 25.5% (13) fairly negative, 2% (1) very negative, 5.9% (3) no impact, and 11.8% (6) did not know. Of the 41 respondents who chose library staff as their preference a total of 12.2% predicted a positive impact, and 70.7% a negative impact. 2.4% (1) predicted a very positive impact, 9.8% (4) fairly positive, 43.9% fairly negative, 26.8% (11) very negative, 0% no impact, and 17.1% (7) did not know. A comparison of these two groups is shown in Figure 17.

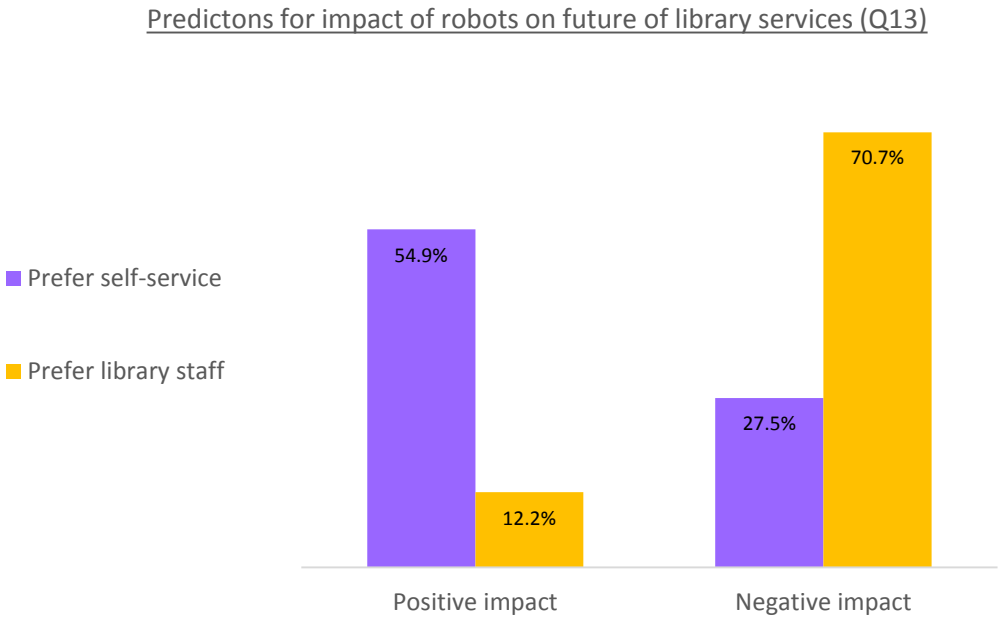

Figure 17

The follow-up question asked respondents to explain why they had given the answer they had regarding the impact of robots in libraries. When the responses were broken down into 'positive', 'negative', and 'don't know' the following themes emerged, with example quotes provided:

Positive (52 responses were given out of 70 who answered 'very positive' or 'fairly positive')

- Release humans from mundane/repetitive work so they can do more interesting things and provide a better service, assisting humans not replacing them:

  *"It could potentially **free up library staff to concentrate on more value added activities**, spend time increasing their knowledge and focus on being more innovative. This would ultimately lead to **a higher level of service for the users**"*

  *"**Frees time for library staff to work on other tasks** not currently given priority (outreach, community work, education, research, etc)"*

  *"Be **good as long as offers better service** Alongside staff, **assisting not replacing staff**"*

- Keeping libraries open and costs down:

  *"Resources are limited so **the use of automation for borrowing books has presumably helped to keep public libraries open**. However, I think this works in my local library because there are still helpful human staff available to assist and provide social contact for those users who need that as much as a book/ information"*

  *"Could do repetitive tasks quickly and efficiently. **May allow cost savings**."*

- Accepting robots/automation but with caveats (e.g. as long as humans still have jobs or as long as the robots function properly):

  *"I can see robots could provide more ready information, perhaps late at night or on-line. However, **I associate libraries with people, and would still want the human touch to be evident in libraries** - ie someone I can talk to, a security guard to keep me safe etc"*

  *"**If they work well, then they should be a benefit to users**. Great care must be taken when trying to turn a 'human' environment to a more 'automatic' environment where people can self serve. **It needs to work seamlessly and in harmony with real staff**. Being a help, not a hindrance. There will always be people who want to speak to a person face to face."*

- Robots can do some tasks more efficiently and accurately than humans, 24/7, consistency:

  "certain roles that do not require human staff could be **made more efficient and be carried out 24/7**"

  *"**Faster** providing enough robots provided."*

- Some users may prefer not to talk to a person when they use a library.

  *"I just think that human customer service is famously bad in London. So **self service is a way to avoid rude people**."*

  *"It will be **good for people who struggle with talking to people** - shy, anxious etc."*

Negative (61 responses were given out of 66 who answered 'very negative' or 'fairly negative'

- Human interaction is crucial and robots cannot provide this as they are not capable of empathy, worries that vulnerable groups would be affected e.g. older people:

  *"One fundamental reason why many people use libraries (especially public libraries) is **the human interaction with the library staff**. Also, **many people, especially older age population, would require training** to understand and be able to use or engage with robots or similar technology."*

  *"I don't think anything could ever completely replace a **human face**."*

  *"One of the most important things about libraries is **the human contact/conversation**, particularly in local libraries where this contact may be the only interaction some people will have that day. I don't know if this is really what you mean by robots but already **the use of automated issuing machines is reducing this contact**. I find it handy to use automated issuing machines but I don't like that in many public libraries using the issue desk is actively discouraged. There is a place and a need for both I would say."*

- Robots may be as good as humans or better at certain tasks, and there are concerns around humans losing jobs:

  *"If we replace service industries with robots, **we will be losing a lot of jobs**; mundane jobs yes; perhaps jobs not fit for humans. If other jobs were created in their place that celebrated human interaction, with an extra emphasis on group activity and social interaction then perhaps automation might work very well. However, in our current austerity climate **I***

***suspect that the roles would not be replaced, and would create a lot of frustration and alienation**."*

*"The tasks mentioned in the previous slide could be done by robots. You're not in a library to talk to people and **I think library workers could be in jeopardy**"*

- Robots not ready for certain tasks yet and cannot deal with the nuances of human behaviour, they are fact-based compared to the more personal and flexible approach of librarians, could lead to loss of expertise:

*"In my opinion, **knowledge is social**. Epistemologies are socially constructed, ratified and sometimes fiercely contested. Given this, the process by which you gain knowledge can be as valuable as what you learn. It should leave space for negative capability, ambiguity, paradox. The search for knowledge should be a quest, and a bit of a mess.*

*I could be wrong, but **I still feel as though robots are designed with the aim of curtailing, or eliminating, as far as possible, that 'questing'**. A librarian can send you off on interesting tangents, encourage you to make connections, explore parallel texts, recommend a philosopher whose work might illuminate the reading of a particular text. A robot aims to provide you with the facts, decontextualised, as though plucked out of thin air. It makes an outcome appear inevitable, teleological. **It makes questions into a question and answers into a fact. That I feel, is a loss**, particularly at a time when leaning is becoming more utilitarian, responsive to the financial crisis and the creativity-sapping employment market."*

- Changing the nature of the library and the roles of library workers:

*"There would be some staff required for things the robot couldn't do but **if I were library staff I would be worried my skills would need to extend to maintenance etc**."*

*"It is **likely to cause a change in how libraries function and changing the traditional roles librarians have had**, which can be seen as positive as well as negative depending on your perspective."*

- Questions of feasibility and the potential things that could go wrong:

*"I value inter-personal & human interaction and think that customer services is absolutely essential in any academic Libraries. I also would feel that robots would be a noisy disruption to the Library environment. **I'm also aware that potentially robots would regularly breakdown, be damaged, get hacked or reprogrammed by external parties**."*

*"People like to ask a human - we all need interaction. **If people were told off by a robot for noise they would take no notice**."*

Don't know (15 responses were given out of 25 who answered 'don't know')

- General uncertainty about the future:

*"Hard to predict whether robots will be seen as a threat or as a great innovation - **still so much mystery and wariness**"*

"I don't know if people would prefer the personal touch a bit more from another human, as opposed to a robot. In my opinion, some people love to chat to the library staff and I think

that this is an element that would definitely be lost. Also, would this mean that some people would lose their jobs, if robots replaced them? That's definitely not an ideal situation. What happens when a robot breaks down/malfunctions half way through the day, what happens then? Will there still be humans around to fill in, whilst the robot is being fixed? ***I'm on the fence on this one. You just don't know how things would pan out.****"*

- Impact would depend on what kind of robot/AI and the context

  *"****I think it depends a lot on what you're talking about****. Providing chat services on the internet with a robot could help increase people's use of libraries by providing 24/7 assistance, for example, thus* ***I think would have a very positive impact. But I don't think having a robot in the library to help people find books would be helpful****. I work in an elementary school library, and when kids come to the library, they don't want a robot to help them find a book. They want a person to talk to about what they like, and books they've read, and books they might want to read. I would imagine it would be the same in public library settings, especially when people are coming to the library for advice about research, applying for jobs, etc. I could be biased, but I rate human-to-human information seeking processes very highly, and don't think they could be effectively replaced by a machine. Think about how frustrated people get with automated phone conversations! They always just want to talk to a person."*

  *"****It depends on the role****. I think at the enquiries desk the impact might be a bit negative in the first instance. Who would love to talk to a robot rather than a human creature who can understand instantly your feelings? Even if you are just looking for the exit but you feel lost or you have to report that you have lost a quite expensive book.*
  About cataloguing books and other materials, the process partially has already started, I don't think the impact would be so traumatic."

  *"****I can't speak for other people. While I might be fine with it, others might not****. People are crazy. The focus is on robots, but they follow programming. AI is an altogether different beast.* ***Robots replacing menial labour is one thing, but roles accepting a machine in interpersonal transactions is entirely another****."*

- Generally unconvinced by the concept.

  "I don't really know ***how widespread or practical*** *it could be"*

  "I feel like robots in a library sort of ***sets a weird tone****."*

4.2. Focus Group

A full transcript of the focus group is located in Appendix A.

4.2.1. Previous technological changes and automation in libraries

Following the moderator's introduction and participants introducing themselves, the first topic for discussion was technological changes in libraries, asking participants to think about their own experiences and how these changes may have had impacts on their work in the past. The first example which came up was the move to computerised library systems from old paper-based systems for circulation, such as Browne Card:

> *'Until I came here, which is my third library job, it's* ***the first automatic computerised library system I'd come across****, so* ***I don't think Browne Card would work in such a large library*** *with so many users and they're allowed to take quite a large number of books out. I don't think it would work, so* ***being able to have a computerised library system suits the large library****. I can still see it working on small libraries, or libraries where they have no power or a very intermittent power source.'*

Although the argument came up that older circulation systems may still be appropriate for smaller libraries and that implementing new systems took time and effort, there was a general consensus that there are many benefits to automated library systems, including saving staff time in the long run, as well as making life easier for library users:

> *'We had to jiggle with it to make it fit our context, but once we'd done that* ***it was so much quicker and easier once that circulation system was in****. I do remember that, I remember we were wondering how it would work and how it would affect the workflow 'cause you think of all the problems it might create...****the time saving was massive****.'*

> *'…it was of obvious benefit 'cause* ***people could manage their accounts themselves****, before it was in a filing cabinet with people's' cards, so* ***it was also better for them****, it linked in with circulation from other libraries, you could have books come in from other libraries as well.'*

> *'…When I joined the IoE we just moved from Libertas, which was like DOS…****it was an improvement for the staff*** *for sure, I'm not too sure about the students because I wasn't really involved with customer service,* ***I just remember a lot of mundane work like loads of letters that we had to put in envelopes in the morning****, so we're not emailing the students 'cause most of the students didn't have an email account.'*

As well as the move to automated library systems, another big change that was highlighted was the rise of the internet and the many ways that had changed libraries:

> *'****One of the biggest things that's happened in my career*** *obviously is the internet.'*

Participants discussed early examples of electronic resources, including CD-ROMs, and how the internet had made access to such resources much easier and not just available in the library building itself:

> *'So all your electronic resources were on these CD-ROM towers and you had to install them and update them, and there was this whole visiting a room on its own and clattering along*

*the fans, and **it was only networked to the library**…of course when the internet really took off, of course we've got all the e-resources and you've got the distance learners…**that's the biggest technological change really isn't it**, being able to access resources from **outside the building**.'*

Although listing the many obvious benefits of the internet in providing easy access to information for library users, participants also discussed some of the teething problems that were faced in the early days of the technology:

*'We would, being a hospital librarian, many of us were just one-man bands so we used to have regional meetings and we'd have some topic or something we'd be learning about, great excitement someone was coming to demonstrate the web! And they'd sit there and go 'oh dear' and **I don't think any of the demonstrations I went to ever worked**. So there was this wonderful thing out there, everybody was talking about it this **saying 'oh it's going to make life really simple' but it didn't work**.'*

The issue of time zones and limited capacity was mentioned, and the idea that when the internet was first introduced in libraries library staff would carry out searches on behalf of users as the availability was so limited, compared to today where library users are much more likely to carry out their own searches:

*'It was before midday, because then all the Americans would wake up and they'd start using it so **all the capacity'd be gone**. So you had to do all your searches, and you did mediated searches as well on this didn't you… **On behalf of users**. They'd put in a sheet and say 'this is what I want' and you'd do the search on dial-up with this little bit of internet and send the result back to them, so that's **a totally different way of doing things than now**, **where people do a lot of their own stuff and then ask us for help sometimes**.'*

Also several participants mentioned the fact that the assumption that everything would be available on the internet straightaway was not always the case, and there was (and still is) a need for hard copy indexes:

*'…**not every subject was represented**, 'cause I was studying music and I remember having to do my music essays and it was like, music index would go back to about 1860 onwards, and if I wanted to do research on a particular topic it was going through every single volume. That would take half a day.'*

There was also some discussion around reprographics technology, and the fact that modern photocopiers, printers and scanners are generally much easier and less time-consuming to use than older technologies such as the Gestetner:

*'**We didn't have photocopiers at the time**, like when I was a student for instance, I remember having to do photocopy with that machine.'*

'The Gestetner'

Although there had been a mention of RFID with regard to automatic issue systems in public libraries, some prompting was required to ask participants to consider the impact of RFID and self-service as new technologies in libraries, and their impact on staff and users. There was a general agreement that both have the potential to save staff time and allow users to be more independent, but also that there were some optimisation and local policy issues:

*'**I think it's been positive for staff definitely**, because at least we don't have to manage queues and **students are more independent** so if they don't want to talk to one of us they can just go and do it themselves. To some extent **I just think our system at the moment…is actually detrimental to the collection**, potentially I have found quite a lot of books that are damaged and don't have a stamp to say that they were damaged so it's really difficult to pinpoint who did it, but literally I've seen the collection deteriorating within the last few months.'*

As the current system at the IoE Library is still under development, with self-service machines that can read RFID but are not yet fitted with the flatbed scanners for reading multiple items, it was acknowledged that some of the potential benefits had not yet been seen:

*'**I think it's positive definitely for the students**, and the fact with the RFID it's so much better like when we have odd shaped books the scanner didn't reach…but I can't wait to have the flat things so we can just like put 5 books together.'*

*'We're not really going to know are we until we've got the full kit in, so **it's very early days**.'*

*'**The flat bed thing is gonna be very good**, 'cause most of the public libraries I use now do have that, and so you can and you can take your little pile of books. **So long as it's working**, it's like all these things.'*

There was also a mention of other potential uses for RFID other than easier self-service, such as searching for missing books:

*'Also the wanding, you know, the shelf checking, for lost items and stuff like that, **we haven't really investigated that**.'*

However, one participant was critical of the technology involved with that:

*'I've seen a demo of that, and **that's quite unreliable**… Yeah it doesn't pick up a lot of stuff, 'cause any 2 tags close together they won't pick it up.'*

Also related to optimisation of the technology there was a discussion about the way library users interact with the self-service machines, and whether they understand the instructions displayed on the screen telling them which book box to put returned items in depending on whether they are reserved or not:

*'There's **an important thing about the user interface of those machines**, and how far we can tailor them, you know the thing with the yellow arrow and the red arrow, it could be better, so the success of these systems depends on how much you can tailor that and how much, how much research have people done about how people interact with those machines, a sort of anthropology thing. They don't see the arrow do they.'*

*'I think it's a human thing that some people see the arrow, and don't look around and think oh it must mean the box but some people don't see that they just see something over there, and they don't know what it means, **they don't necessarily connect the screen, and what happens with the screen and what happens with the real world around them**.'*

Finally, there was some consideration of practical issues with RFID, regarding the sizes of the tags and how they are not appropriate for certain items:

> *'I was going to say **I have a problem with the size of the tags**, and this came up when that I was working in a music library 'cause you've got sheet music, it's usually printed on both sides, where do you put the tag? It's too big. You know, and then in the end you end up sort of creating a cover.'*

> *'Even when we were putting tags on our books, some of our books are quite old on Level 5, and I kept having to say **we shouldn't cover this 'cause that's quite important information** you know? Inside the book, and we were covering it.'*

A response to this was the idea that new technology does not have to be perfect to be implemented, as long as it provides a solution for the majority of the problem and can be justified with cost-benefit analysis:

> *'I guess with anything like this though, **it's gonna be a fit for 90%** or whatever %... **There's always gonna be a percentage of things with any tech you look at that isn't going to be entirely suitable**.'*

> *'And when your senior people are looking at that they say ok it does 90% **so the cost benefit analyses we're doing**, it doesn't do the 10%'*

4.2.2. General attitudes towards robots

Participants were shown the same definition of a robot that was given in the online questionnaire (based on the European Commission surveys of 2012 and 2014) and asked if it matched their idea of what a robot is. There was a general level of agreement in the group, but also some debate around the difference between 'robot' and other terms such as 'cyborg':

> *'Something which is **more human looking like terminator**, or the things in I, Robot. With much more of a...to me **a cyborg is something which is more human looking**.'*

There was also a consideration of the difference between everyday appliances and robots:

> *'I suppose it makes me think, the bit you've put at the end, I'm not quite sure **where the boundary is between what's just an appliance and what's a robot**.'*

> *'See I look at it as **something that's programmable**, but that's me. The set of instructions that you've got there, that's a program, it's **a complex set of instructions that then lead it to do what you need it to do**.'*

This led to debate around the concept of intelligence, and whether programming could lead to robots or machines being considered intelligent or simply programmed:

> *'But **are we talking about intelligence then?** You see because you're talking about programmable and I'm thinking to myself oh well then in a way you can programme your coffee maker to come on a certain time, right? But **where's the intelligence here?**'*

'Strictly I would say, you'd have the analogue, which is basically like a clockwork thing, but that's not the same to me as a program, a program is you know, a PC, instructions, but there is that thing about ***when is a computer really intelligent in the way a human is?****'*

Participants gave examples of what they would consider as an 'intelligent' machine, but still with the idea of programming behind it:

'Well for me, it would be like if it checks that I was really tired, by my body temperature, or my heart beat, or whatever, and then decided to give me an extra half an hour in bed 'cause it decided I was too tired to wake up, then ***there's an intelligence built into this****, you see? So* ***it's a programme, as such****.'*

'And it decides to ***do my job for me but I still get paid****.'*

Participants were then asked how they felt about the prospect of robots or Artificial Intelligence becoming more prevalent in society, and if this was something they had thought about. This led to a discussion around acceptance levels and the ethical issues that could arise. In terms of acceptance one participant raised the idea that robots are being made to mimic humans in a different way to traditional industrial robots, and that this could either be for functional reasons or so that people will be more accepting:

'They have, you see lots of things on...YouTube. You see pictures of them ***trying to get them to walk****, and that sort of thing, because quite a lot of the ones which you have in your factories, they are, they don't really move around, they're sort of mainly static and then they paint the cars and things. It might move a little bit but not,* ***they don't really choose where they're going****. The thing which vacuums your floor, it sort of has sensors so that it's not gonna just end up knocking on your bottom of your wall,* ***so they do seem to be trying to mimic humans****. Human actions. Whether this is, they think they'll be more useful that way, or* ***whether we'll be more accepting of them****…'*

The issue of a new technology being 'good enough' was raised again, with the idea that robots may be capable of carrying out certain tasks but not as well as humans:

'I think there's ***an element of acceptance****, 'cause* ***they're never gonna be as good as us****. But when you think about it, if I was gonna vacuum my floor I know that I would do a really good job, I'm gonna get underneath the sofas, move the sofa, I'd get into the corners and stuff like that…. You know that when you put one of these cleaners in, it's not gonna do that, and you know that* ***you're gonna get a 60%/70% job*** *if you're a perfectionist like me.'*

A concern which was raised was that even if machines have been originally programmed by a human, increased autonomy would mean that we may not be able to change the programming in future:

'….at some point, they're in control of something that you don't like the decision but ***someone's made the decision 10 years previously when it was programme****d or whenever it was previously, someone's detached, the human's detached from that decision but the program, it's in the program. And* ***what do you do if you don't like that decision****, and how can you do anything about that if it's in the program, the application.'*

'Well they should, when they program them, build into it ***the ability to reprogram it****.'*

One participant drew a connection here with the existing technology of Multi-Functional Devices (MFDs) used in the library for printing, scanning and photocopying:

> *'…if you look at our MFDs, and the problems with them, that's exactly what you've just said really.* ***We wanna be able to change them****, I was asking yesterday can we change the error messages, so the students know what the error is? It can't be done. It's* ***hard coded*** *into it, so that's a good point, it depends how well they do it, and what they're doing, and to me it's like* ***let's get them to do as much drudge as possible so we can do some more interesting things.****'*

There is an acknowledgement here that if automation is done well it can release humans from mundane work, but also that new technologies can inadvertently cause problems and lead to frustration at first. Related to the ethical issues around programming was how much we are willing to trust supposedly intelligent machines:

> *'…when you look at Siri, you know on the Mac or whatever the Android equivalent is, you believe them, you trust them, because, most people, because* ***everybody goes to Google for their first port of call****. Everybody goes, and there's a kind of* ***element of trust*** *here, Google's gonna get that information for us, they're gonna get us from A to B sort of thing, and certainly because Siri is used to checking Google for a lot of the information, there's an element of trust here. You know? But* ***if you talk to Siri, and talk to it like a human, you get complete nonsense****.'*

Driverless cars were mentioned, raising the idea that people may be willing to accept robots and AI for certain tasks but not others and an ethical dilemma:

> *'****I don't want them driving a car****, that worries me to heck, the idea of self-driving cars.'*

> *'…there's an* ***ethical problem****. If you set it to be programmed to drive a car, be programmed to avoid pedestrians, if a pedestrian walks out in a tunnel. There's a specific problem where there's a tunnel with a pedestrian who will be killed if the car goes straight on… Or there's another car coming the other way, and six people might be killed if the car swerves to avoid the pedestrian,* ***the computer program would say kill the pedestrian****.'*

Overall there was a consensus that robots and AI were likely to become more prevalent and that this could be beneficial for people, but that there are also many practical and ethical concerns about how and where this will happen.

4.2.3. Attitudes towards robots in the library

For the group activity the participants were divided into two groups and asked to rank the examples of library robots (see appendix) by order of 'most comfortable' to 'least comfortable'. There was much debate in both groups about the order of the ranking, with the orders chosen showed below:

Group 1

1. Basic chatbot
2. Security guard
3. = Shelver/Assistant
4. Advanced chatbot

Group 2

1. Basic chatbot
2. = Shelver/Assistant
4. Security guard
5. Advanced chatbot

Group 1 unanimously chose the basic chatbot as the idea they would be most comfortable with as they felt it would be 'nice and static'. One of the group members chose the security guard in second place, as they thought it would be good not to have to deal with the disciplinary side of library work:

> *'We wouldn't have to keep telling people not to use their phones…**it's really difficult**.'*

The other group member was less comfortable with this as they were not sure the users would like it:

> *'I really don't think I'd like a machine coming up and telling me to stop talking on my phone…**it might end up as a squashed machine'***

There was also some disagreement around the potential use of the robot shelver and the assistant, but a compromise was reached:

> *'[redacted] was very keen on the robot shelver that would be able to identify and locate different library...and **I didn't think this was feasible**, and we'd have to have extremely large shelves. Whereas I thought that a robot assistant that would help you find your way around the library, **that might be quite fun**. So that's why those 2 ended up equally, 'cause we're compromising.'*

As with the basic chatbot, there was complete agreement on the placement of the advanced chatbot:

> *'…an online Library Chatbot, available 24/7 that would provide an advanced enquiry service e.g. guidance on search methods, **we didn't really think that this would work**, we think that this is where **interaction with humans is still the best**.'*
>
> *'That's because we have to really **get to the bottom of the enquiry**.'*
>
> *'You have to be able to **change direction**, according to what, as you go on with your search.'*
>
> *'And **interrogate** the user.'*

The second group agreed that the basic chatbot should be at the top and the advanced chatbot at the bottom for very similar reasons to the first group, but also had some debate around the order of the middle three, with questions being raised about feasibility and acceptability:

> *'**We didn't on the whole think the security guard would work**, for some of the reasons [redacted] and [redacted] were mentioning, especially it would be **a red rag to a bull** to try and outwit the robot security guard. So I didn't think that would work at all. The other 2, the assistant that would help you find your way around the library, **I didn't like but some people did**.'*
>
> *'For me, it was because that's **a feasible thing that can be done**, whereas the other one, which was the robot shelver I just don't think it's feasible because of **the complexity** of, you know, stock and…'*

There was an acceptance that a shelving robot may be suitable in certain environments that could be tailored specifically for the technology, but this may not work with the IoE Library specifically:

> *'…our shelving isn't like that, it's fluid, the boundaries of each shelf change as we get new books, slot them in, classification schemes don't work in that way. So **the cost** of retrofitting*

*the library each time that happened would **outweigh the benefit** of having the robotic shelver.'*

However, one participant pointed out the hypothetical nature of the question:

*'Well this is whether we're comfortable with it or not, **I'm perfectly comfortable with it if it works**.'*

Another participant raised the ethical issue of human employment being affected by automation, which two others strongly agreed with:

*'We wouldn't have all of our wonderful shelvers, and we wouldn't be providing work for people, **are we going to take jobs away from people?**'*

'That's true.'

'Very good point.'

Again one participant noted that they had not been thinking of that side of the debate:

*'I was thinking about it **more in terms of capability**, than in terms of **ethical issues**.'*

After the group exercise and discussion, participants were then shown the real-life examples of robots that the descriptions had been based on (see appendix). They were asked to comment on them, and to say whether seeing the real examples changed the opinions they had expressed previously.

With regard to the examples of an automated storage and retrieval system (ASRS), the initial responses showed that some participants were already familiar with the concept and one had seen the example given:

*'**I've actually seen this** at Boston Spa.'*

'And it's a closed door isn't it, a closed stack.'

'You can go and visit the Reading Room and put in requests and they will produce the stuff for you.'

When first shown AuRoSS there was a recognition of how this was a different technology to existing ASRSs:

*'So it is **not shelving**.'*

*'And do you actually have to keep your shelves like that so the machine can do the work, so **you've gotta do all that work so it can do its job?**'*

For 'Hugh', 'Bob', and 'Xiaotu' the initial responses revolved mainly around their appearance:

Hugh:

'Oh it's K9'

'Can't we just train dogs here?'

Bob:

> *'He's so **cute**.'*

Xiaotu:

> *'Do you notice you've still got to wind it up?'*

When asked if they would reconsider the order they had previously put the examples in, some respondents said they would, particularly with the idea of a robot security guard:

> *'I think I'd put the security guard **to the bottom** now.'*

> *'As cute as he is, I'm not so sure he has **authority** or **presence**.'*

> *'It'd be a **novelty** at first, and then after I think definitely they'd be like **let's mess with the robot**.'*

The same issues of feasibility and suitability were raised about a robot shelver:

> *'The shelving system, in that circumstance, **works in that particular environment**, that particular place, I think they couldn't cope as well as they do without it. **It must make their lives so much simpler, but what happens if it goes wrong**, drops it in the wrong box? Sorry I'm very gloomy.'*

The response to AuRoSS was generally positive, again with some caveats around feasibility:

> *'Well, I guess you could have it do a scan of everything night and when the place is shut, it would be **able to find books a lot easier than we would**, that's what a computer could do. Actually find the lost books, **that's a great application for this**.'*

> *'The one that is scanning, I thought that would be **very useful** if...but **you seem to have to do a lot of work before the shelves are ready for it to do that**, and to keep them like that.'*

> *'Well **you'd have to program it**, 'cause I mean we've got different types of shelves, different heights, different numbers of bays, so it'd have some kind of, I dunno, **shelf mapping**. See where I'm going with this, a shelf map like we used to have on our OPAC, where you told it how big everything was and gave it a plan, and it would know where it was, **I don't think that's too hard?**'*

4.2.4. Thoughts about the future of library work

After being shown the different robots participants were asked how it made them feel about the future of library work, and how their roles could potentially be affected. The idea that library staff could be given more time for more interesting work was again raised, but this was also accompanied by potential fears around job losses:

> *'**It's always difficult** to look into that, because while you can see that in theory, and being positive, **you lose the drudgery and then you get to do the more interesting stuff**, but then you're also worrying well if there's a bit less drudgery **they don't need so many people so there aren't as many jobs**. In theory it's all very positive **when you get to do the more***

> ***interesting stuff**, I can see that, 'cause you want to be answering these queries not those queries, so the queries should be complex.'*

One participant also made the observation that users may become frustrated with robots if they were unable to deal with their requests, and then library staff would be left to deal with the problems:

> *'You'd also be **dealing with a lot of problems**, so **troubleshooting all the time**…people would come to you after they've exhausted all the things there and **they might be really frustrated**, because the length of time that they have actually spent and that wasn't successful, and then **they finally get to the person that's supposed to be the expert**, the librarian.'*

Another issue raised was the question of who would be responsible for repairing the new technology when it goes wrong, and how this could actually create new jobs for people.

> *'So **that's when you need to have people there**, to fix those things, but those people need to be actually in the organisation, not in another organisation and outsourced. So, again, you're back to…**that's where your new jobs are**, there's people that need to look after this stuff and program it.'*

While one participant saw this as a potentially positive opportunity for library staff to move into, there was also an acknowledgement from another that some people may struggle with learning new skills:

> *'So **you're going to have to retrain people**, which sounds marvellous, but **can be quite difficult in some situations** 'cause not everybody is…good at learning pernickety things.'*

The response to this was that the technology should be designed so that the basic operations and repairs can be carried out easily by everyone, or even so it can repair itself:

> *'That's why **it needs to be much simpler**, and that's what I'm saying is that these things should be designed so we don't have to all learn all the things about it but there's someone whose job that is to do, rather than it being our job.'*

> *'…you need that technology that's going to sort of **take care of itself**. And it's going to, perhaps, fix itself in some way, you know **that's where again the intelligence comes in** because if we're not feeling well we'll take a paracetamol or something, what does the robot do in terms of fixing itself?'*

Despite the issues raised, one participant in particular thought it would definitely be a good thing to have some tasks taken off their hands:

> *'But I think actually **it would release us to do a lot more interesting work**, in terms of being embedded in the whole **teaching and research process**, which we don't have time to at the moment 'cause we're on desks. For me, it would be absolutely brilliant. Also in terms of curating content, we would focus on that more, and I think **provide a better service as a result of that**. I think that we would be able to promote our collections better, as we'd have all this expertise which I think is kind of watered down…We either don't have time to talk to each other, we actually don't have time to think sometimes…'*

Participants gave varying answers when asked how they felt about the ways robots and AI are named and described, for example as 'robot librarians', with some dismissing it as 'silly' but another describing themselves as feeling 'threatened':

> *'I do feel, if you say robot librarian, **you do feel threatened** because you think Siri's taking over your job, and **you know that Siri's not gonna do a good job**, yet you think that the public are gonna think, because they already do, that Google provides all the answers, you know? So you do feel threatened, and you do feel kind of **sad for the future of humanity**, because if you're gonna give crap, garbage in garbage out'*

One participant raised the point that the opinion of library users would be key, especially the younger generation:

> *'…what's really important is **what young people think of them**, not what we think of them. You know, people…that are coming to universities, how would they see them I wonder? Whether it would just be like a gimmick to them, they wouldn't think these things could take care of it or whether they would, I don't know I just think it's interesting that. **We need to know more about what they think**.'*

Although overall there was a general acceptance that robots or machines could be used to further automate some of the more routine parts of library work in future, the idea of empathy emerged as a key concept that should limit what we allow robots to do. This was highlighted as being particularly important for dealing with more complex enquiries from users, where a purely fact-based approach is often not what users may want:

> *'I had an older woman come to me today for a one to one, and she was apologetic, she was looking in my eyes, you know, and **she wouldn't have gone away satisfied if she'd had a robotic response to her** - 'yes well you're stupid that's why you don't know how to do this'…or that kind of feeling as if she wasn't actually getting to me and telling me that she was very sorry that she didn't understand what she was expected to do.'*
>
> *'That **human emotion**, that open heart approach to communication.'*
>
> *'Empathy. **Robots do not have empathy'***
>
> ***'Empathy's** the key thing.'*

Just before ending the group one of the final comments made by a participant was that '*It'd be interesting to come back in 10 years' time. See what happened.'*

5. Discussion

The findings of the online questionnaire will be discussed first, followed by those of the focus group. There will then be a consideration of how the findings relate to each other, as well as to the literature and previous studies. The quantitative findings from the online questionnaire will be compared to the equivalent findings from the European commission survey of 2014 (findings published in 2015) for the same questions, as well as broader links being drawn from the literature and other surveys.

5.1. Survey

5.1.1. Potential biases - library workers and differences in library usage

As previously acknowledged the total sample for the survey contained a disproportionate percentage of library workers (24.8%), which is why another group was selected as a point of comparison, and to mitigate the potential biases of library workers. This group was defined as 'recent library users', and was made up of the 23.6% of respondents who said they had used a library within the past month or more recently, but were not also library workers, and it was felt that they would offer a good point for comparison when considering the issues raised by the survey as their experiences of libraries would be more fresh in their minds compared to those who had not used library services as recently. It is also recognised that overall the 41 library workers were skewed towards the older age categories compared to the sample as a whole, but it was found that age was not a significant factor in explaining the differences between the views of library staff and the total sample.

As was shown in the literature review there are arguably specific implications of different technologies for different types of libraries and library user, such as different applications of RFID and self-service for public and academic libraries (discussed by Palmer (2009) and Fortune (2016a, 2016b)), and advanced AI-enhanced legal research services for law libraries (discussed by DeAizpura (2016)). For this survey, there was a clear majority of public (54%) and academic/research (35%) library users in the sample. While comparisons could be drawn between the types of libraries respondents said they were most likely to use and the responses they gave, this distinction will not be made as the purpose of this study is to draw conclusions and predictions about the potential impact of automation on libraries in general. However, this is certainly something that could be explored for future research.

5.1.2. Self-service and RFID

When considering the responses people gave regarding their use of self-service and their awareness of RFID, we can consider the evidence presented by Palmer (2009) that self-service systems operating with older barcode technology do exist, but that those that use RFID technology are far more likely to be used. Interestingly, while a majority (79.1%) of respondents had used a self-service machine in a library, only 51.2% of these respondents also said they had used a library with RFID. However, this can perhaps be explained by the fact that 34.1% of respondents who had used self-service answered that they were not sure if they had used a library with RFID, despite a definition of RFID being provided with the question. The large number who expressed an uncertainty could arguably suggest that the respondents had used RFID but were just not aware of it, as it is the kind of technology that is essentially invisible to people and designed more to enable machines to easily read it, tying in with Floridi's (2014) idea of the 'infosphere'.

Unsurprisingly the amount of library workers who had used self-service (97.6%) was much higher than the total sample, and also those who said they had used a library with RFID (85.4%), which would be expected due to library workers' increased exposure and awareness of these kinds of technologies. Interestingly there were similar responses from library staff when compared to the total sample with regard to their preference for borrowing or returning items, with the least popular option being to do so through a member of library staff for both groups, and a majority having no preference or choosing self-service. It may have been predicted that library workers would be slightly more negative towards the use of self-service machines than the rest of the sample, but these results would suggest that there has been a certain acceptance of the technology. This could support Palmer's (2009) arguments that such technology can be seen as beneficial to library workers as it releases them to do more interesting things, as shall be discussed below.

5.1.3. What is a 'robot'?

The words and phrases listed by respondents when thinking of the term 'robot' draw out some interesting ideas around peoples' general perceptions of what robots are and what they can do. In line with the European commission (2012, 2015) surveys it was decided not to explicitly mention the term 'Artificial Intelligence' in any of the wording for the questions or other information in the survey, as it was felt this may influence respondents to think about robots in a certain way. The fact that the term did emerge as something related to robots, as well as in other free-text responses, demonstrates that some respondents were definitely aware of the connection between robotics and AI, but most did not refer to it at all. Several synonyms and alternative terms for robots also appeared, such as 'android', 'drone', 'automaton', and the more general terms of 'machine' and 'computer'.

When the results were coded and sorted into themes, the most common theme to emerge was the idea of automation, suggesting a general awareness of the idea that robots can be used to carry out work. It should be noted that the word 'automation' was included in the title of the survey and the introduction, so this may have influenced respondents' answers. However, the prominence of other potentially related themes and terms such as 'Efficient', 'Redundancy', and 'Car manufacturing', shows that some respondents were certainly thinking about the different reasons robots can be used to carry out human work, and the potential results of this.

As is argued by authors such as Winfield (2012) and Kaplan (2015) the influence of ideas from fiction on the general public's concept of robots was definitely present in the responses. 'Sci-Fi' and 'future' emerged as two of the most common themes, with many related terms and specific references to famous characters from films and books such as 'terminator' and 'R2-D2', as well as references to the well-known author Isaac Asimov. Respondents also demonstrated a slightly cautious and cynical view of robots, with terms related to ideas that robots are 'impersonal', 'non-human', 'non-emotive', 'inflexible', and 'unfriendly', perhaps supporting the ideas of researchers such as Chui, Manyika & Miremadi (2016) who suggest that even if robots are capable of carrying out the same jobs as humans they may not be able to provide the equivalent of the 'human touch' that many people look for, and this could be key to their acceptance.

5.1.4. Comparisons with European Commission surveys – general attitudes towards robots and the threat to employment

Although percentages have thus far been presented to one decimal place, the European Commission findings (2012, 2015) were presented with no decimal places so the same will be done in this section

of the analysis for the purposes of comparison. The second European Commission survey found that 14% of respondents had used or were currently using a robot at home, work or elsewhere, an increase of 2% compared to the original 2012 survey (European Commission, 2015). For this survey it was perhaps surprising that only 13% of respondents said they had used or were using robots, as it may have been expected to see an increase, supported by the evidence in the literature that robot sales and usage have been rapidly increasing in recent years (University of Sheffield, 2016). As with all of these comparisons, the much smaller size of the sample, and its less representative nature compared to the European Commission surveys (2012, 2015), should of course be taken into account, but it would seem to suggest that the general populations' exposure to robots in real-life Is still fairly low.

The European Commission (2012, 2015) surveys also identified that the variable of whether respondents had used a robot had an influence on their general attitudes towards robots, with those who had generally being more positive towards their potential uses. it was decided that the base size of 21 respondents in this survey who said they had used a robot was too small to draw any significant comparisons with those who had not, but an alternative measure related to respondents' preferences with using self-service will be used in a similar way.

An important comparison can be drawn with respondents' general attitudes towards robots between the surveys, as can be seen in Figure 18. For the total sample of this survey a slight increase can be seen in those who reported a positive view of robots compared to the European Commission survey, from 64% to 66%. This could be seen as surprising when considering that the European Commission survey had seen a drop in the proportion of respondents expressing a positive view compared to the original survey, from 70% to 64%. Combined with the data on robot usage it could suggest that general public opinion of robots is unpredictable, and not just dependent on technological advances over time, as discussed by authors such as Kaplan (2015) and Bollegala (2016).

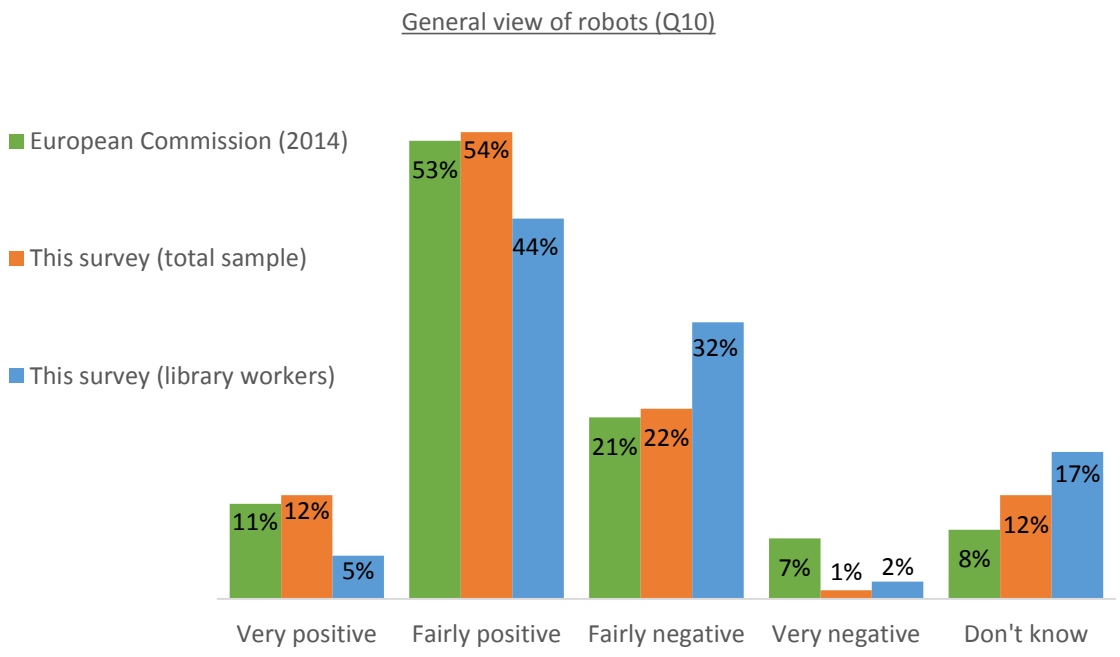

Figure 68

An interesting difference can also be seen with the answers of library workers, who were less positive towards robots than both the European Commission respondents, and the total sample for this survey. This kind of difference is also reflected in Figure 19, where it can be seen that library workers were much more likely to think that their job could be done by a robot in future when compared to the total sample and the European commission results published in 2015. Although we cannot draw a definite link between respondents' expressed views towards robots, and their perceived potential that their jobs could be automated, it is an important point to consider.

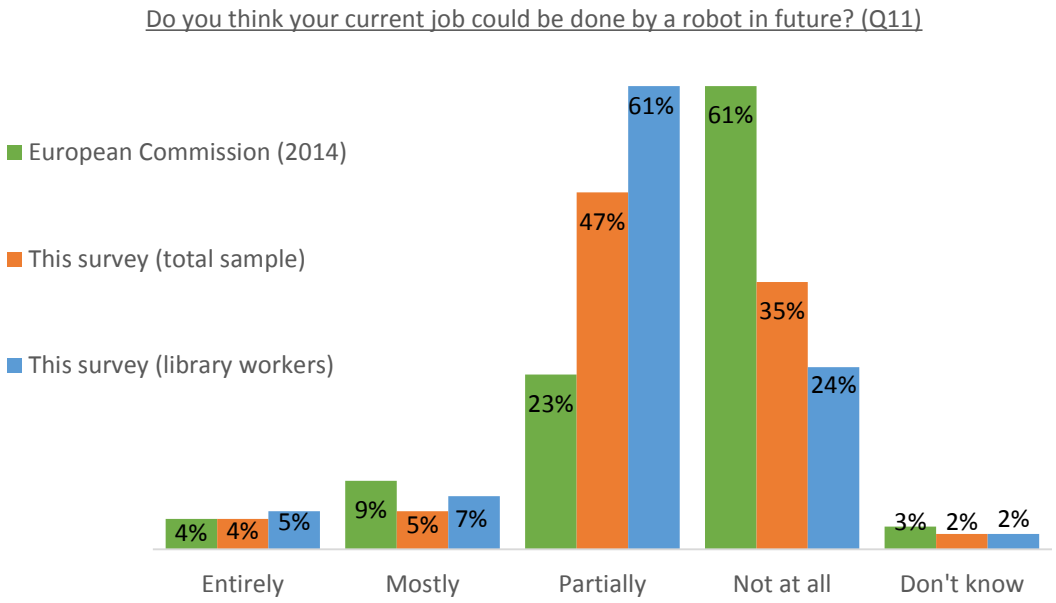

Figure 19

As was demonstrated in the literature review, there has been much written in recent years about the increased likelihood of robots and AI 'taking over' a greater range of human jobs, and the increase in those who thought this could personally affect them in the total sample compared to the European Commission survey suggests that these ideas have entered the popular consciousness. The even higher percentages for library workers could indicate that they feel particularly threatened, a position that is supported by the predictions made in Frey & Osborne's (2013) research, with the findings for the UK that librarians had a 52% likelihood of automation within the next two decades, and library clerks and assistants a 97% likelihood (Stylianou, N., Nurse, T., Fletcher, G., Fewster, A., Bangay, R., Walton, J., 2015).

As we do not have a breakdown of the specific job roles of the library workers in this survey we cannot determine whether they would fit into the 'librarian' or 'library clerk and assistant' category, and we also do not know the jobs of the other 124 respondents so further analysis cannot be carried out at this point in terms of the differences between the views of library workers compared to other professions. It should also be observed that the percentage of respondents, out of the total sample and of library workers, who thought that their jobs could be 'mostly' or 'entirely' done by a robot was actually around the same level or lower than in the European Commission survey of 2014. This could potentially reflect the idea of 'symbiotic automation', and the view that smart machines will increasingly work alongside humans but not necessarily replace them completely (Brandom, 2016).

As can be seen in Figure 20 there were also some differences in the responses given to various statements about robots. Interestingly, the number of respondents who agreed that robots steal peoples' jobs in this survey was actually lower than in the European Commission (2014), particularly for library workers, which supports the idea that respondents may think it more likely that robots will be able to do parts of their job but that this does not necessarily mean their jobs will be completely 'stolen'. As with the European Commission findings published in 2015, it can be seen that respondents could certainly see the advantages of robots, with a majority of the total sample and library workers agreeing that robots are a good thing for society and that they are necessary for hard and dangerous jobs, providing evidence for similar views in the literature from authors such as Ford (2015) and Srnicek & Williams (2015). The calls for a cautious approach to developments in robotics and AI from commentators such as Kaplan (2015) and Floridi (2016) is also supported by the fact that the statement that most respondents agreed with was that robots are a form of technology that requires careful management.

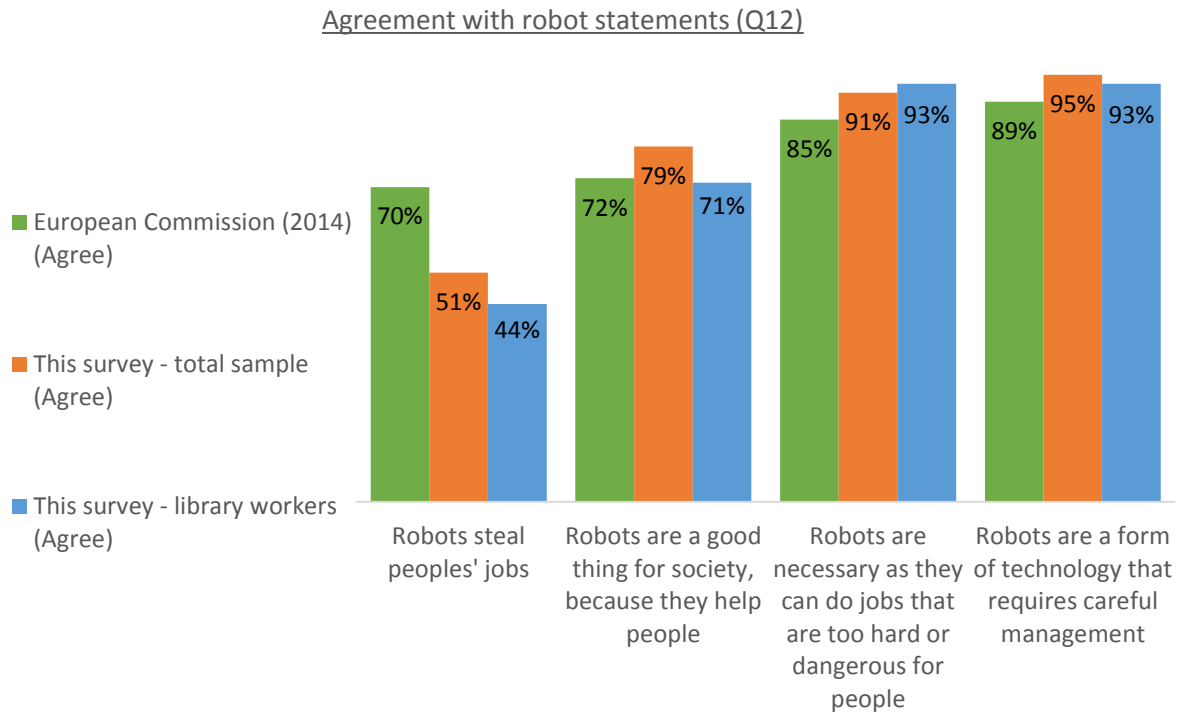

Figure 20

5.1.5. Acceptance levels of 'robots in the library'

As previously discussed, the definitions given for the different examples of 'library robots' were all based on the examples in the literature review to varying extents. As some respondents may have heard of, or even come into contact with, the real-life examples, it should be acknowledged that this may have created some biases in their responses. To attempt to mitigate this, and to create a consistent approach in the descriptions, the decision was made to present the general concepts behind the existing examples as roles that could 'potentially carried out by robots in libraries', rather than explicitly naming them. Although respondents in this survey were considering different examples of robots to those given in the European Commission (2012, 2015) and British Science Association (2015) surveys, there was a similar finding in that respondents clearly felt more

comfortable with the idea of some robots than others. Again this perhaps provides support to the theories of Chui, Manyika & Miremadi (2016) regarding the acceptability of robots being dependent on complex cultural and social factors.

Some distinctions were drawn between different groups in the sample, demonstrating that library workers had significantly lower levels of comfort overall with each of the examples of library robots compared to the total sample. An obvious explanation for this would be that they perhaps felt threatened by the idea of robots that could carry out their work, but we have seen with previous questions regarding general attitudes towards robots and the potential for work to be automated, that the truth is likely to be much more nuanced than this. This was shown by the fact that comfort levels of 'recent library users' were also found to be significantly lower than those of the population as a whole, again suggesting that there are different reasons for apprehension about the use of robots in libraries other than simply library workers resisting automation. The focus group drew out further important issues related to the ideas of comfort levels with different types of library robot, as shall be discussed.

Another distinction was drawn between respondents who had chosen self-service as their preferred method of returning/issuing items and those who had chosen library staff, as it was predicted that the former may be more positive towards the different library robots having shown an acceptance of existing automation technologies, and the latter more negative. This was shown to be true, particularly with the idea of the robot 'security guard', the robot 'assistant', and the robot 'shelver', which all received a significantly higher level of comfort from the respondents who chose self-service as their preferred method. While firm conclusions should not be drawn here, it is interesting to consider that while on one hand there may be a need for human interaction in libraries, as argued by Lewis (2016), on the other there are people who may actively prefer not to deal with a person for certain things and would be more likely to accept increasing automation. This conflict also emerged in some of the qualitative information acquired, as shall be shown.

5.1.6. Predictions for the future

Some key comparisons and observations can also be made when considering the question around the potential impact the use of robots for role traditionally carried by library staff would have on library services, which is enriched by the qualitative data gathered in the accompanying free-text responses and the focus group. Overall there was seemingly a level of uncertainty or reluctance to commit to a strong viewpoint when answering this question, with the majority of respondents answering with either 'fairly negative' 'fairly positive', rather than 'very'. This is to be expected as making any kind of prediction about the future can be difficult, as reflected in the varying literature around the future of robots and AI. However, what was clear was that compared to the total sample and to those who said they preferred using self-service for borrowing/returning items, library workers, recent library users, and those who preferred to use library staff, were significantly less positive about the impact robots may have in libraries.

This again raises questions about the various reasons why some groups may be more apprehensive about the use of new technologies than others, and the reasons people gave for having a positive, negative, or uncertain view can provide some invaluable insights into this. Perhaps the most significant reason given for feeling positive about the increased use of robots was the view that it may release library workers from having to do mundane tasks and would allow them to provide a better service to users, similar to the arguments of authors such as Willcocks (2016), and Palmer (2009) in his discussion of the benefits of RFID. Veloso's (2012) concept of 'symbiotic autonomy' is

not explicitly mentioned, but similar ideas around the idea that robots will be beneficial if they can work well with humans and not just replace them. Also raised was the idea that increased automation would be a positive thing if it meant money could be saved and more libraries could stay open, and also the idea that some people actually may prefer not having to deal with a human for certain tasks, as is supported by the data on preference over self-service use.

On the more negative side there was the popular idea that human interaction is a crucial part of why people use libraries, and that the increased use of roots or AI could have a disproportionately negative affect on vulnerable groups such as older people who rely on these interactions. This again ties in with ideas around public acceptance of new technologies, raised by Bollegala (2016) and Chui, Manyika & Miremadi (2016), but the evidence in the literature would also suggest that developing robots that are better for caring for people is now seen as a big priority around the world so perhaps the current criticisms of their lack of 'humanity' may change in future (University of Sheffield, 2016). Other criticisms were raised about the capability and feasibility of robots working in libraries, with the key idea that even though robots may be capable of providing a fact-based response this may not be what library users actually need or want, and the more nuanced approach of a human librarian is more appropriate for the kinds of complex enquiries they may have, an issue which also came up in the focus group.

There were also concerns voiced about the impact robots in libraries could have on employment for library staff, with similar concerns to the ones raised by Ford (2015) and Srnicek & Williams (2016) that there may be some new and more interesting jobs created as a result of automation, but that the overall result would be job losses, which our current economic system may not be able to handle. Connected to this was the idea that rising automation will change the traditional role of library workers, as outlined by Lewis (2016), and that new skills will need to be learned whether they want to or not. The general consensus across all of the responses given, and indeed when considering the survey data as a whole, would seem to be that people hold a range of nuanced views on robots and the automation of library work. Although particular factors could be seen to explain the differences between the groups identified, such as fears of job loss or familiarity with library services and the need for human interaction, there were also apparent contradictions with the generally positive attitudes towards robots, and areas where a more in-depth approach could provide valuable insights. For this purpose, the results of the focus group will now be considered.

5.2. Focus Group

As previously discussed the five participants in the focus group were all recruited from the IoE Library, and had all completed the online questionnaire before the group took place. It should be acknowledged therefore that there may have been potential biases introduced by the author, not only through the fact that participants had already seen the questionnaire and may have been influenced by its content, but also in their personal contact with the author and awareness of his research. However, as already explained in the research methods section, there are benefits to carrying out focus groups as a follow-up to surveys, and also amongst groups who already know each other (Carey & Asbury, 2012; Stewart & Shamdasani, 2015).

5.2.1. Importance of personal experiences of technological change in libraries

The initial discussion around participants' personal experiences with technological change in libraries seemed to follow a similar pattern to the narrative presented by Lewis (2016), with the move from the 'paper library' to the 'automated library', and then to the 'digital library'. As with Lewis (2016) there was a recognition from participants that technological changes, such as converting old card-based systems to computerised systems, were time-consuming for the staff carrying the work out, but that they could certainly see the long-term benefits for both staff and users of the changes being made.

Several interesting points were raised with regard to the internet, with the idea that the technology was adopted early in libraries and had obviously significant implications for users in terms of being able to access digital information from outside the library building, but also that there issues with its use early on due to poor connections and limited bandwidth. This can be linked to the debate highlighted by authors such as Palmer (2009) that the internet can be seen as a threat to libraries, and it was acknowledged that library users are now able to do much more on their own than before, but also the idea that not everything is available on the net.

When discussing RFID and self-service there were significant observations made about the need for optimisation and the potential limitations of the technology if not used properly, as discussed by authors such as Palmer (2009) and Fortune (2016a, 2016b). Again it should be mentioned that the IoE Library is currently still in the process of implementing RFID, with the vast majority of stock now tagged but self-system machines still operating on a hybrid barcode/RFID setting. However, the general consensus was that RFID has already been beneficial to users, and has saved staff time and repetitive work in dealing with queues of people trying to return or borrow books, arguably supporting some of the claims of Palmer (2009). While they were not asked if they would personally rather use self-service as a library user, as with the questionnaire results the positive sentiments shown seemed to suggest that library staff are generally not against self-service machines.

In terms of optimisation the was some discussion of the possibility of using RFID for stock management through 'wanding', but as with Li, Huang, Kurniawan & Ho (2015) this idea was dismissed as ineffective. There was also a consideration of the problem with RFID tags not being appropriate for certain library materials due to size or shape, but the idea of cost-benefit analysis and that technology can often be implemented without being perfect as long as it is seen to have enough of a benefit was raised, as was also demonstrated in the literature (Xerox, 2016).

5.2.2. General attitudes towards robots – are they 'intelligent' or just 'good enough'?

As with the results of the questionnaire the debate around the definition of a robot again highlighted that people can often base their views of robots on Sci-Fi, with the Terminator making another appearance. There was also some debate around the given definition in terms of the difference between a robot and an appliance, leading to considerations of how machines are programmed and whether this can be seen as 'intelligence' or not, as discussed by authors such as Handman (2016) and Floridi (2014, 2016).

The potential that robots may be deliberately designed to mimic humans to make them more acceptable to us, as discussed by Kaplan (2015), was raised by one participant when referring to robot vacuum cleaners and the way they sense their surroundings. The key idea of acceptance was then debated further, again with the notion that for some people machines may just need to be 'good enough' to be accepted in the place of humans, but that others would not agree with this. This is supported the findings of the survey that respondents had different levels of comfort for the various robots proposed, and that this also varied across the different groups identified.

An interesting connection was made when talking about the potential problems that could be experienced if robots could not be reprogrammed, with one participant referring to an existing issue with the library's multi-functional devices (MFDs), used for printing, scanning and photocopying. Again it was acknowledged that technology can release humans from 'drudgery', but that it can also lead to frustration and time being wasted if it is not implemented well. On the topic of how machines are programmed, some ethical concerns around the use of robots was raised, including the driverless car dilemma mentioned in the literature review.

5.2.3. Attitudes towards robots in the library – feasibility, acceptability and ethics

It was felt that by asking the participants to carry out the ranking exercise with the examples of 'library robots' this would refresh their memories of answering the similar question in the online questionnaire, and could draw out some of the potential reasons that the results showed varying comfort levels for the different robots. Again the disagreement and debate that emerged demonstrates that people can have different reasons for their acceptance of new technologies, with the issue of technological feasibility being raised, but also ideas around ethics and the need for 'human interaction', perhaps supporting the argument of Chui, Manyika & Miremadi (2016).

Although the robot 'security guard' had been identified in the survey as the idea that respondents would feel least comfortable with across the sample as a whole as well the other groups identified, the participants in the focus group were slightly more positive towards it. One interesting explanation for this was the justification raised by one participant that they thought it could do the kind of jobs they did not like doing, such as 'telling library users off'. This potential benefit for library workers could explain why they showed a higher comfort level overall in the survey results when compared to 'recent library users'. However, there was a general consensus in the group that library users would not like to be told what to do by machines, and this was reinforced when participants were shown the real-life example of Bob as they thought it would not be taken seriously.

There was also a clear distinction drawn between the two 'library chatbots', with all participants agreeing that they were less comfortable with the idea of the one that could handle more advanced enquires, which was also reflected in the survey results, particularly by library workers. Again we return to the idea that people may be willing for some tasks and parts of their roles in libraries to be

automated, but that some such as those related to in-depth enquiry work, are seen as too important and still requiring human interaction, as discussed by Bell (2016) and DeAizpura (2016).

The questions of feasibility reflected Floridi's (2014) concept of the 'infosphere', with the idea that for some robots to work there would need to be a lot of changes made to the library environment first, and that this would create too much extra work for humans. However, as has been demonstrated with previous technologies, such as the movement to automated library systems for circulation and cataloguing, this does not necessarily mean that the changes will not be made as there is often an acceptance of the long-term benefits. A key argument that was raised at this point was that the robots may not be undesirable due to their lack of feasibility, but because they could put peoples' jobs at threat, a point which has emerged throughout the literature and also within the survey findings.

In discussing the different 'library robots' it had emerged that some participants were already aware of some of the real-life examples they were based on, particularly ASRSs such as the British Library's robotic cranes, which potentially shows that such systems are already relatively well-known by library workers. However, when they were shown the images and descriptions of AuRoSS, Hugh, Bob, and Xiaotu, it was clear from their reactions that most had not seen them before. It was also intended to show participants a short video about the implementation of robots Vincent and Nancy in Westfield Public Library, but as the group was running slightly behind schedule a decision was made by the author to skip this example. The further debate that continued around the potential feasibility and appropriateness of these robots for the IoE Library, with some acknowledgement that a system such as AuRoSS could be successfully implemented but that Bob could not for example, supported the idea that people are not necessarily willing to accept new technologies just because they have been used elsewhere, and that there are significant other factors involved.

5.2.4. Predictions for the future of library work – freedom from 'drudgery' and saved by empathy

While there appeared to be a general acceptance that automation can have positive impacts where it frees up humans from 'drudgery', the concerns shown about potentially being left to deal with only the more difficult enquiries and frustrated users, or simply being replaced altogether, demonstrate that these issues should be considered and debated further. As discussed, this was also demonstrated with some of the limited qualitative information in the survey when respondents were asked to explain how they felt about the potential use of robots in libraries, and supports the ideas of Srnicek & Williams (2015) and Kaplan (2015) that our current economic systems may not be seen as adequate to deal with the changes that could be coming to the job market. Srnicek and Williams' (2015) idea of a deliberate push towards full automation, accompanied by implementing a Universal Basic Income (UBI), was not raised in either the responses to the survey or the focus group, so it could be argued that these kinds of radical ideas have not yet entered the mainstream, but the various concerns raised show that people are certainly looking for solutions and reassurance about the future.

Perhaps the key concept that arose in the focus group was that despite the view that some library work could and should be handed over to robots or AI, allowing people to concentrate on more interesting work such as promoting the collections, and ultimately provide a better service to users, there was also a consensus that empathy was a key factor that human library workers have which sets them apart from machines. This idea of the importance of the 'human touch', as described by DeAizpura (2016), is one that has emerged as a crucial part understanding what kinds of automation people are willing to accept in both the survey and the focus group. Although some, such as Bell

(2016), may argue that library workers may not hold the advantages of empathy and creativity over machines for much longer than the next decade, as things stand it seems to be a huge hurdle for them to get over before they can be seen as equivalent.

5.3. Further Research

Overall it can be seen that the results of the survey and the findings of the focus group combined well to provide a range of quantitative and qualitative information related to the research aims and objectives laid out in this dissertation, and these findings were well supported by the literature and related studies. However, there are certainly some limitations and areas where further research would be required to draw firmer conclusions.

Some ideas have already been mentioned, such as the potential usefulness of including other employment demographics in the survey other than just library work as a basis for comparison between professions, and also making more of a comparison between the implications of automation for different types of libraries. Also, it was decided in this project not to distinguish too much between different library workers at this stage, albeit with some discussion around the idea that 'librarians' may be less at risk than 'library assistants' in line with Frey & Osborne's (2013) research. In the demographics questions of future studies there could therefore be a further breakdown of the different job roles that are carried out in libraries, such as shelver, library assistant or librarian, and specialities such as cataloguing or systems, to establish whether there are different attitudes to automation amongst different types of library worker, and if some feel more at threat from robots/AI than others. This could potentially act as an accompaniment to the research of those such as Frey & Osborne (2013) who have tried to establish the extent to which particular jobs are at risk.

Also, in line with commentary that suggests that it may be possible to reduce working hours in future, or completely remove the need for humans to work at all, due to the gains in efficiency and profitability that could be brought about by automation, research could be done to establish the extent to which library workers may be willing to work less and their views on systems that could supplement their incomes such as UBI. Although there may be an assumption that most people would want to work less if they could still be paid the same amount, some interesting points were raised in the focus group about the fact that people may not want to let go of all the 'drudgery' in their work, as it can provide variety and a break from more complex tasks, so this idea might be worth further exploration.

The survey results were able to draw out comparisons between library workers and different library users, but the focus group was more limited in that only library workers were recruited. Further focus groups could be carried out with library users, or a combination of library users, library workers and non-library users, to draw out more meaningful and in-depth qualitative comparisons of peoples' attitudes towards automation of library services. This could also help to explore the reasons behind the apparent connection between a preference for using self-service machines, and a more positive attitude towards the potential for the increased use of robots in libraries.

With regard to the 'library robots' that were referred to in this research there could also be an attempt to fully evaluate and compare the success of their implementations. As discussed they are at various stages of development and testing, but for the robots that are currently operational it would be useful to actually see them in real life and test them, which time and financial constraints of this project did not allow. This could be accompanied by in-depth interviews with their developers and stakeholders, as well as anthropological research, observing how library workers and users interact with the robots to establish the impact that such technology can have.

6. Conclusion

Although making any kind of prediction for the future is difficult, this project aimed to use a range of evidence and opinions to form a picture of how library services and library work may be affected by the undeniable advances that are taking place in robotics and AI. The literature presents a clear consensus that the kinds of jobs that were once seen as only suitable for humans, in the non-routine cognitive and manual categories, are now becoming increasingly susceptible to automation. This evidently includes many of the tasks carried out by library workers, with increasingly advanced robots and AI already being implemented for work such as shelving, patrolling, stock-checking, training and handling enquiries, albeit largely on an experimental level at this stage.

According to the results of the survey there are differences in general attitudes towards robots, and 'library robots' more specifically, between those who are already accepting of existing automation in libraries and those who prefer to deal with human staff members. This could suggest that certain people may already be willing to accept a future where robots and AI are much more prominent, but that others are more reluctant and may resist such change. It was also shown that while library workers may have generally had more negative views towards 'library robots' than the sample as a whole, this was not necessarily just because they felt that their jobs were threatened. What can be concluded, is that on the whole people seem to hold nuanced views about automation, and can often see both the positive and negative aspects, supported by the debates that took place in the focus group.

A key finding related to peoples' acceptance of the different types of robot is that the perceived feasibility of new technologies is certainly important, and there can often be hesitation and cynicism around implementation if technology is seen as not yet 'good enough' or too time-consuming to enable, but that there are also many other important social and ethical factors that can influence people. While there is an acknowledgement that certain tasks in libraries that may be seen as 'mundane' should be automated where possible, as this will release workers to do more interesting things, there is also a feeling that this may lead to an undesirable change in the nature of library work or the loss of certain jobs altogether.

Overall the concept that perhaps emerged most prominently is that the human quality of empathy is considered a crucial part of what library workers do, and enables them to provide the kind of tailored and flexible service that many users want. This was supported by examples in the literature, findings in the survey, and discussions in the focus group. There is evidence to suggest that the work being done to create robots and AI that can more convincingly emulate these kinds of human qualities may be successful in coming years, and that even if machines never become truly 'intelligent' in the same way that humans are they may be able to achieve the same results to the extent that they are indiscernible. However, based on the barriers that remain with areas such as natural language processing, speech recognition and mobile robotics this kind of progress could be many years away. Also, as has been shown, even if technology is feasible it does that mean that people will accept it, so as long as libraries continue to exist there will arguably always be a need for humans to run them. As discussed, there is much further research that could be done around this topic, and a clear need for ongoing debates about the issues raised.

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Appendix A: Research Tools and Full Results

Online Questionnaire

Attitudes towards Robots and Automation

Page 1

Hello,

Thank you for choosing to complete my survey, which will contribute towards my dissertation project for an MSc in Library Science at City, University of London.

The aim of my research is to explore advances in automation, and the potential impact this may have on areas such as human employment. Although there will be a focus on library services, this survey also explores broader issues so you do not need to be a library user or worker to participate.

This is an anonymous survey, and any information given will be confidential and not passed on to any third parties.

The survey can be completed by anybody aged 18 and over, and will take roughly 10-15 minutes to complete.

Many thanks,

David Phillips

Please press the 'Next' button to begin

Page 2

How would you best describe your use of library services? *

Using library services could involve visiting a library in person (e.g. to borrow books, use a computer/study space, ask for advice etc.), or accessing library resources remotely (from home or elsewhere).

- ◯ I currently use library services regularly (at least once a month)
- ◯ I currently use library services occasionally (less than once a month)
- ◯ I don't currently use library services but I have done regularly in the past
- ◯ I don't currently use library services but I have done occasionally in the past
- ◯ I have never used library services

Page 3

When did you last use a library service? *

- ◯ Today
- ◯ In the last week
- ◯ In the last month
- ◯ Within the last year
- ◯ Longer than a year ago

Which type of library are you most likely to use? *

- ◯ Academic/research
- ◯ Public
- ◯ Medical
- ◯ Law
- ◯ School
- ◯ Other (please specify) _____

Which of the following library services/resources have you ever made use of? *

Please select all of the answers that apply to you

- ☐ Books/other items for reference use (inside the library)
- ☐ Books/other items for borrowing (to use outside the library)
- ☐ Online resources accessed inside the library
- ☐ Online resources accessed remotely
- ☐ Study spaces
- ☐ Advice/training from library staff
- ☐ Organised groups/social activities
- ☐ Computers/other IT equipment
- ☐ Other (please specify) _____

Page 4

Have you ever used a self-service machine in a library for borrowing or returning books/other items? *

- ◯ Yes
- ◯ No

Have you ever used a library with RFID technology? *

- ◯ Yes
- ◯ No
- ◯ Don't know

Given the choice, would you prefer to borrow/return library items through a member of library staff, or by using a self-service machine? *

- ◯ Library staff
- ◯ Self-service machine
- ◯ No preference
- ◯ Don't know

Page 5

When you think of the term 'robot' which words or phrases first come to mind?

There are five boxes below but please feel free to use as many or few of them as you like.

1 _____

2 _____

3 _____

4 _____

5 _____

Page 6

Have you ever used, or are you currently using robots at home or at work (e.g. a robotic vacuum cleaner at home or an industrial robot at work)? *

A robot is defined as a machine which can assist humans in everyday tasks without constant guidance or instruction, e.g. as a kind of co-worker helping on the factory floor or as a robot cleaner, or in activities which may be dangerous for humans, like search and rescue in disasters. Robots can come in many shapes or sizes and some may be of human appearance. Traditional kitchen appliances, such as a blender or a coffee maker, are not considered as robots. Also, for the purposes of this survey, self-service machines such as those currently seen in supermarkets or libraries are not considered as robots.

- ◯ No
- ◯ Don't know
- ◯ Yes, at home
- ◯ Yes, at work
- ◯ Yes, elsewhere (please specify) _____

Generally speaking, do you have a very positive, fairly positive, fairly negative or very negative view of robots? *

- ◯ Very positive
- ◯ Fairly positive
- ◯ Fairly negative
- ◯ Very negative
- ◯ Don't know

Do you think your current job could be done by a robot in the future? *

- ◯ Entirely
- ◯ Mostly
- ◯ Partially
- ◯ Not at all
- ◯ Don't know
- ◯ Not currently working

Page 7

To what extent do you agree or disagree with each of the following statements about robots? *

	Totally agree	Tend to agree	Tend to disagree	Totally disagree	Don't know
Robots are a form of technology that requires careful management	◯	◯	◯	◯	◯
Robots steal peoples' jobs	◯	◯	◯	◯	◯
Robots are necessary as they can do jobs that are too hard or too dangerous for people	◯	◯	◯	◯	◯
Robots are a good thing for society, because they help people	◯	◯	◯	◯	◯

Page 8

Below is a list of roles that could potentially be carried out by robots in libraries. For each of them, using a scale of 1-10, please rate how you would personally feel about it. *

On this scale, '1' means that you would feel "totally uncomfortable" and '10' means that you would feel "totally comfortable" with this situation.

	1 (Totally uncomfortable)	2	3	4	5	6	7	8	9	10 (Totally comfortable)	Don't know
A robot 'assistant' that would help you find your way around the library (e.g. physically leading you to items on the shelves)	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
A robot 'shelver' that would be able to identify and locate different library items and physically return them to their correct locations	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

An online 'library chatbot' available 24/7, that would answer basic enquries about the library (e.g. providing opening hours, directions, basic library account information etc.)	○	○	○	○	○	○	○	○	○	○	○
An online 'library chatbot' available 24/7, that would provide an advanced enquiry service (e.g. guidance on search methods, accessing digital databases, evaluating sources etc.)	○	○	○	○	○	○	○	○	○	○	○
A robot 'security guard' that would patrol the library (e.g. to monitor for noise disruptions and other issues with the library environment)	○	○	○	○	○	○	○	○	○	○	○

Page 9

Can you think of any other uses for robots in libraries?

This can be theoretical, or based on real-life examples that you have experienced or heard about.

What impact do you think the use of robots for roles traditionally carried out by human library staff would have on the services provided for library users? *

- ◯ Very positive
- ◯ Fairly positive
- ◯ Fairly negative
- ◯ Very negative
- ◯ No impact
- ◯ Don't know

Why do you think this?

Page 10

Are you currently working in a library (paid or voluntary)? *

- ◯ Yes
- ◯ No

Page 11

Which type(s) of library do you currently work in? *

You can select mutliple answers if you work in more than one type of library.

- [ ] Academic/research
- [ ] Public
- [ ] School
- [ ] Law
- [ ] Medical
- [ ] Other (please specify) _____

Would you be willing to take part in some follow-up research?

I plan to carry out a focus group with 5-10 library workers to discuss similar issues in more depth - I would be very grateful for any willing participants.

- ◯ Yes (please contact me at david.phillips@city.ac.uk for more details)
- ◯ No

Page 12

Thank you, almost done...

What is your age? *

- ◯ 17 or younger
- ◯ 18-20
- ◯ 21-29
- ◯ 30-39
- ◯ 40-49
- ◯ 50-59
- ◯ 60 or older
- ◯ Prefer not to say

What is your gender? *

- ◯ Female
- ◯ Male
- ◯ Prefer not to say
- ◯ Prefer to self-describe (please specify) _____

In what country do you currently reside? *

◯ United Kingdom

◯ Other (please specify) [ ]

Page 13

Thank you very much for completing my survey.

Some of the content is based on two earlier surveys carried out by the European Commission - if you are interested in the results of those surveys you can find them in the links referenced below:

European Commision (2012) 'Public Attitudes towards Robots'. Available at http://ec.europa.eu/public_opinion/archives/ebs/ebs_382_en.pdf (Accessed 20/4/16).

European Commission (2015) 'Autonomous Systems'. Available at http://ec.europa.eu/public_opinion/archives/ebs/ebs_427_en.pdf (Accessed: 20/4/16).

If you have any questions or comments about this survey, or my dissertation project in general, please contact me at: david.phillips@city.ac.uk

» Redirection to final page of eSurvey Creator (change)

Questionnaire Results

Attitudes towards Robots and Automation

1. How would you best describe your use of library services? *

Number of participants: 165
56 (33.9%): I currently use library services regularly (at least once a month)
22 (13.3%): I currently use library services occasionally (less than once a month)
42 (25.5%): I don't currently use library services but I have done regularly in the past
43 (26.1%): I don't currently use library services but I have done occasionally in the past
2 (1.2%): I have never used library services (routed directly to question 8)

2. When did you last use a library service? *

Number of participants: 163
24 (14.7%): Today
29 (17.8%): In the last week
23 (14.1%): In the last month
33 (20.2%): Within the last year
54 (33.1%): Longer than a year ago

3. Which type of library are you most likely to use? *

Number of participants: 163
57 (35.0%): Academic/research
88 (54.0%): Public
5 (3.1%): Medical
3 (1.8%): Law
5 (3.1%): School
5 (3.1%): Other
Answer(s) from the additional field:
- Porno shop
- Children
- on-line platform for specialist books
- Japanese language related
- Hospital library

4. Which of the following library services/resources have you ever made use of? *

Number of participants: 163
135 (82.8%): Books/other items for reference use (inside the library)
154 (94.5%): Books/other items for borrowing (to use outside the library)
90 (55.2%): Online resources accessed inside the library
88 (54.0 %): Online resources accessed remotely
100 (61.3%): Study spaces
58 (35.6%): Advice/training from library staff
32 (19.6%): Organised groups/social activities
101 (62.0 %): Computers/other IT equipment
6 (3.7%): Other
Answer(s) from the additional field:
- Area to display information and staging events
- Wank booth
- DVD rental
- DVDs
- Talks
- Collected leaflets about local events/places of interest

5. Have you ever used a self-service machine in a library for borrowing or returning books/other items? *

Number of participants: 163
129 (79.1%): Yes
34 (20.9%): No

6. Have you ever used a library with RFID technology? *

Number of participants: 163
68 (41.7%): Yes
33 (20.2%): No
62 (38.0 %): Don't know

7. Given the choice, would you prefer to borrow/return library items through a member of library staff, or by using a self-service machine? *

Number of participants: 163
4 1 (25.2%): Library staff
51 (31.3%): Self-service machine
70 (42.9%): No preference
1 (0.6%): Don't know

8. When you think of the term 'robot' which words or phrases first come to mind?

Number of participants: 162
1 - Asimov
- AI
- kids toy
- technology
- Glitch
- The Future
- Automated
- Will Smith
- T in can
- Automation
- r2d2
- mechanical
- Sci-fi
- Mechanical
- Machine
- Automated
- Artficial
- Wars
- K9
- Technology to make lives easier
- Glitchy
- Machine
- Automated
- Simple
- automaton
- Asimov
- Daleks
- automated
- Machine
- Computer
- Machine

- Future
- Automation
- Artificial intelligence
- Mechanics
- Automation
- Doom
- Metal
- Automatic
- Robbie
- Impersonal
- Machine
- Dancing
- Automation
- Future
- square
- Sci fi
- Artificial intelligence
- Rigid
- Robot wars
- Computer
- Automatic
- Not personal
- Virtual
- Drones
- Terminator 2
- sci fi
- Wars
- Box
- Metallic humanoids made of box shaped structures
- Terminator
- Automation
- Isaac Asimov
- Droid
- Simondon's critique of notion of robot
- Automated services
- Wars (tv show)
- machine
- unreliable
- Mister
- terminator
- Drone
- Automation
- Technology
- Cool
- future
- Machine
- metal
- artificial intelligence
- automated
- Machine
- automaton
- lost in space
- Mechanical
- Science Fiction
- metal
- Redundancy
- automatic
- Machine
- automated production
- More then meets the eye
- Humanoid figure
- Automated
- Inhuman
- Labour saving
- AI
- Automation
- inflexible

- automation
- Machine
- MACHINE
- restrictive
- Slave
- futuristic
- Machine
- automated process
- Automated
- 21st Century
- a machine
- Future
- Impersonal
- Technology
- Human like
- Machine
- Non human
- Futuristic
- czech origins of word
- metal
- android
- Automaton
- automated
- Bots as in questionable practices on the web
- Android
- Less manpower
- sci-fi
- Complex technology
- AI
- automaton
- Not human
- electronic
- T he future
- Quick process
- Interesting
- johnny number 5!
- Machine
- Humans (Channel 4)
- Machine
- Robbie
- Machine
- Silver
- robocop
- any automated machine
- Three laws
- Automation
- R2D2
- Space
- Science
- Electrical
- Internet bot
- rigid
- friendly
- automated hoover
- R2D2 in Star wars
- anonymous
- cold
- repetition
- Sci-Fi
- Machine
- Science fiction: like the novel later filmed as 'Bladerunner'; the film 'I, Robot'; the 1920 s play 'Robot'
- technology

2 - Drone
- Helper
- cyborg
- useful
- Inflexible

- Artificial Intelligence
- Unintuitive
- Terminator
- Roomba
- Accuracy
- c3po
- computer
- AI
- Humanoid
- Help
- Technology
- Metal
- IRobot
- T he future
- Sci-fi
- Hackable
- Non-human
- Rigid
- Fast
- isaac asimov
- impersonal
- Humanoid
- Machine
- Metal Micky
- Technical
- Future
- T oy
- Futuristic
- Steel
- Fake
- Heart
- Mechanical
- Mindless
- Flawed
- Self sufficient
- Sci-Fi
- Convenience
- Unemployment
- metal
- Cold
- Self driving cars
- Faults
- Fast
- Not human
- Programmed
- Non thinking
- Manufacturing robots
- Hard as fuck
- artificial intelligence
- Children's toys
- Cool
- Welding arms making cars
- Computer says no
- Maria (from the film Metropolis)
- Rosie the Robot
- Master/slave model for machinic relations
- Not being able to communicate with a human to ask a question
- Automation
- servant
- inflexible
- Search engine
- car manufacturing
- Drone Strike
- Technology
- Automation
- Error
- android

- Non-human
- self-service checkouts
- machine
- efficient
- No contact
- android
- Cold
- Artificial intelligence
- inhuman
- Future
- futuristic
- take over the world
- labour saving
- Asimov's laws
- Worker or servant
- Building cars
- Logical
- Fair
- Future
- Mechanical
- unfriendly
- intelligence
- Rules
- NO HUMAN INT ERACT ION
- quick
- Automation
- quick
- Sci fi
- CP3O,
- Process
- Modern
- R2D2
- Automation
- Unfriendly
- Killer
- Lack of communication
- Automatic
- Automated
- Quick
- mechanised
- beep boop
- humanoid
- Machine able to do predetermined tasks
- westworld
- Automation
- Machine
- Automatic
- computer
- Automation
- Autonomous
- metal
- no emotion
- eyes
- No frills
- Frustrating
- technology
- Programmed
- Efficient
- Metal
- Mechanical man
- Humanoid
- Metal
- japan
- self service
- Capek
- Glitches
- C3PO

- Freaky
- Space
- Inhuman
- Science Fiction
- metal
3 - Automaton
- Army of robots
- aluminium foil
- efficient
- Embarassing
- The Terminator
- Impersonal
- Roomba
- Science fiction shows/movies
- Artificial Intelligence
- peter crouch
- Issac Assimov
- Metal
- Wars
- Unthinking
- Sophisticated
- 21st century
- Future
- Taking jobs away
- Ignorant
- Non-caring
- Dependent
- laws
- restricted choices
- Useful
- Regimented
- Manufacturing
- Complicated
- Assistance
- Autonomous
- Artificial intelligence
- Impersonal
- Bladerunner
- T ireless
- Convenient
- Scary
- "I'll be back"
- Making life easier
- Innovation
- technology
- Drone
- Breakdown
- Modern
- Technology
- Boring and repetitive functions
- Bomb disposal robots
- Antennas n shit
- Image on clothes
- Easy
- Robot wars
- R2D2
- Metal
- Dancing
- In disguise
- science
- frustrating
- Self awareness
- johnny 5
- Japan
- Future
- Machine
- Fun

- progress
- Automated
- scanners
- quick
- Impersonal
- machine
- Distant
- Machines
- stupid
- Frustrating
- impersonal
- Walle
- Companion
- Terminator with Arnold Schwartzeneger
- Unreliable
- Slightly alienating
- Hacking
- Lack of choce
- sinister
- death
- FEAR OF UNKNOWN
- easy
- Robbie
- clever
- Malfunction
- artificial intelligence
- Computerised
- Machinery
- something that might break down
- Futurama
- Money saving
- Android
- Lack of information
- South African traffic lights
- unfriendly
- automation
- Machine able to replace human labour
- Non-human intellegence
- Controlled
- Faster
- machine
- Limited actions or restricted abilities
- Service
- future
- Metal
- digital
- linear
- Curious
- Impersonal
- Impersonal
- Artificial intelligence
- T V shows
- Like humans but square!
- cleaning robot
- emotionless slave
- A.I
- Convenient
- Terminator
- Humans
- One task
- Easy
- No feelings
- technology
- at my service
- car building
- no emotions/ feelings
- automated machine

- industrial
- no feelings
- Star Wars
- Tools of surgeons
- machine
4 - Soulless
- Futuristic
- making people redundant :(
- quick
- Cyber
- Automation
- Cost saving/Redundancy
- tin foil
- Android
- Humanoid
- Impersonal
- T he future
- Daleks
- Ugly
- Impersonal
- long way to go
- usually efficient
- Car Factory
- Inflexible
- Dalek
- Efficient
- Technology
- Television/movie
- Future
- Disaster
- Toy
- One-size-fits-all
- Future
- Laws of robotics
- electric
- Future
- Micro movements
- Passport control robots
- Factories
- Giant
- Dalek
- Westworld
- Mechanical
- Artifical intelligent
- wars
- Science fiction
- Robot Butler
- Danger
- Not human
- Complicated
- efficient
- beep
- cost-saving
- sci-fi
- Impersonal
- Automated
- unattractive "computerised" voice
- machine
- Science fiction
- Data
- Efficiency
- inhuman
- helper
- NOT ACCURAT E
- electronic
- Automatic
- impersonal

- R2D2
- car manufacturing
- not a human
- Sad
- Space
- Efficient when done properly
- science fiction stories
- retro
- labour saving
- Machine doing repetitive tasks
- Web-crawling
- Programmed
- Efficient
- automated
- Movement
- machine
- Cynical
- Quick
- Metal Mickey
- Funny
- The chilis song
- the robot dance move
- Terminator
- Streamlined
- Bertha
- Machines
- Computer
- future
- not human
- software
- metallic
- memorising poems
- Robots to do housework
- Machines in space exploration
- android

5 - Unknown
- sex robot
- robocop
- My Life As a Teenage Robot
- Artificial intelligence
- Productivity
- Bertha
- Futuristic
- Sci-fiction
- Dangerous
- Unaccomodating
- power
- ok till it breaks down
- Terminator
- Automated
- Unfriendly
- Terminator
- Automation
- Cold
- Infinite monkey theorem
- Robot fighting league
- automated
- Walking robots
- Connected
- Mechanical sex toys
- Kraftwork
- Create
- Cool
- cyborg
- Inflexible
- Intelligence
- Mechanical

- Strange
- sex-toy
- touch screens
- Broken
- Limited interaction
- unreliable
- Anime/manga
- Useful
- schwarzenegger
- MAY BE FUN!
- frustrating
- Construction
- scary
- Scary
- reducing jobs for human
- lack of empathy and interrelational skills
- Asimov
- repetitive task
- Machine able to replicate output exactly
- Futuristic
- Star wars
- Versatile
- android
- Manufacturing
- space
- Terminator
- Efficiency
- Mechanical
- Clever
- Can't ask questions
- take-over
- dumb
- sience fiction
- whipping the cream
- Computer technology is taking over the world!
- Gadgets, toys, and 'assistants' in Japan - damaging mental health of children and elderly in particular

9. Have you ever used, or are you currently using robots at home or at work (e.g. a robotic vacuum cleaner at home or an industrial robot at work)?

Number of participants: 165
137 (83.0 %): No
7 (4.2%): Don't know
8 (4.8%): Yes, at home
11 (6.7%): Yes, at work
2 (1.2%): Other
Answer(s) from the additional field:
- Hoover on ma nob
- My neighbours' Amazon's Alexa :)

10. Generally speaking, do you have a very positive, fairly positive, fairly negative or very negative view of robots? *

Number of participants: 165
19 (11.5%): Very positive
89 (53.9%): Fairly positive
36 (21.8%): Fairly negative
1 (0.6%): Very negative
20 (12.1%): Don't know

11. Do you think your current job could be done by a robot in the future? *

Number of participants: 165
6 (3.6%): Entirely
8 (4.8%): Mostly
78 (47.3%): Partially
58 (35.2%): Not at all
3 (1.8%): Don't know
12 (7.3%): Not currently working

12. To what extent do you agree or disagree with each of the following statements about robots? *

Number of participants: 165

	Totally agree (1)		Tend to agree (2)		Tend to disagree (3)		Totally disagree (4)		Don't know (0)
	Σ	%	Σ	%	Σ	%	Σ	%	Σ
Robots are a good thing ...	29x	17.58	102x	61.82	20x	12.12	2x	1.21	12x
Robots steal peoples' jo...	11x	6.67	73x	44.24	62x	37.58	11x	6.67	8x
Robots are necessary as...	64x	38.79	86x	52.12	10x	6.06	-	-	5x
Robots are a form of tec...	93x	56.36	64x	38.79	7x	4.24	-	-	1x

13. Below is a list of roles that could potentially be carried out by robots in libraries. For each of them, using a scale of 1-10, please rate how you would personally feel about it.

Number of participants: 165

	1 (Totally uncomfortable) (1)		2 (2)		3 (3)		4 (4)		5 (5)		6 (6)		7 (7)		8 (8)		9 (9)		10 (Totally comfortable) (10)		Don't know (0)
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ
A robot 'security guard' t...	44x	26.67	20x	12.12	19x	11.52	13x	7.88	12x	7.27	14x	8.48	12x	7.27	7x	4.24	7x	4.24	15x	9.09	2x
A robot 'shelver' that wo...	5x	3.03	8x	4.85	4x	2.42	5x	3.03	13x	7.88	4x	2.42	18x	10.91	21x	12.73	22x	13.33	64x	38.79	1x
An online 'library chatbot...	9x	5.45	5x	3.03	6x	3.64	3x	1.82	7x	4.24	13x	7.88	11x	6.67	29x	17.58	20x	12.12	60x	36.36	2x
An online 'library chatbot...	11x	6.67	7x	4.24	10x	6.06	9x	5.45	12x	7.27	16x	9.70	15x	9.09	25x	15.15	20x	12.12	39x	23.64	1x
A robot 'assistant' that w...	18x	10.91	11x	6.67	16x	9.70	12x	7.27	14x	8.48	12x	7.27	18x	10.91	19x	11.52	10x	6.06	34x	20.61	1x

14. Can you think of any other uses for robots in libraries?

Number of participants: 70

-Tidying/cleaning,
-I have seen some libraries that have robots that sort the books that are being returned into different categories based on where they go in the library - these are then shelved by a human. Idk I don't think libraries really need robots... maybe a shelving robot would be nice, as long as it was spot-checked by a human sometimes.

-It would be helpful if a robot would make an announcement to be quiet if the sound became too loud, instead of having to find a librarian to come tell other people in the library.

-Siri-like interactions

-Food services (ie bussing)

-Membership. Auditing.

-Roaming robot with disposable headsets and menus from which patrons can select and listen to trial excerpts from new audio books/music. Maybe.

-Teaching, providing information, security, cleaning & entertaining.

-foot stools
punch bags

-Cleaning robot, Good for dusting shelves and Books

-Robots that help people with disabilities (maybe guiding blind people through the venue)

-Borrowing and returning books/cds/dvds. Sorting machine that sorted the returned books. Always jammed and the sorted books always had to be checked as it errored often.

-Helping to read stories to children

-Retrieving and returning from archive like the robots used in the BRITISH Library newspaper archive.

-assisting disabled

-Algorithms of books to recommend books maybe being used by robots.

-Artificial intelligence assistance in finding and selecting articles- like a Google Scholar version of Google's assistant

-I'm not entirely sure the library is the right place for a robot. A librarian is an iconic part of libraries and part of the experience. I can't imagine wanting a little robot buzzing around while I'm sifting through books 📚 Maybe they could help doing the cleaning...

-Handing out tissues to people who continually sniff. Particularly in winter.

-No

-Robots could serve in the café area.

-Knowledge depository, give info from books based on questions from user. Suggest further reading. See more: snow crash, Neal Donaldson

-No

-A wank robot to stand in the corner n toss you off n shit, could clean up the mess to (possibly, not sure if technology is ready for this)

-a robot to manage study space or IT facilities within a library. e.g. keeping track of available space/facilities

-Make opening hours longer by providing lending and information services like literature searches.

-Deliver coffee and tea

Finding specific passages and references within a book

Highlighting other relevant materials

-Cleaning

-Anything to save money as many libraries are closing in the US due to lack of funding

-Perhaps we could think instead of uses of libraries for robots. You've seen Short Circuit, right?

-Not at the moment.

-I don't know how a robot would be useful for this, but I always hate having to pack up my computer and valuables when I go to the bathroom, and then bring them back... maybe it could guard them for me?

-no

-Noise cancelling robot - finds noisy people, projects the inverse of any sounds they make mapped to the shape of the room. This should probably be paired with the security bot, so that someone doesn't start getting murdered and the noise cancelling bot silences them.

I sense a new franchise... in the library, no one can hear you scream.

-Turning noisy people into quiet little cubes

-As a study assistant that can highlight and save passages from books. Robots that can provide recommendations based on either questions or previous borrowings.

-For simple and mechanical tasks, robots are fine. For higher order thinking (choosing books to order, answering detail queries etc.), people are much better.

-Finding and reshelving misplaced items.
Locating misplaced reservations.
Shelving.
Identifying and compiling statistics on categories of material, e.g. items without an RFID tag.

-I think that if you could get a robot to kick people out of the library that would be awesome. When they infringe rules. That would be the best. Also if they could stop people talking on their phones remotely. They problem would be when they try and use the library as a HQ to orchestrate world domination.

-Remind students not to eat (or drink).
Help with the IT issues
Tidy up desks
Monitor use of space.

-Gathering and crunching useful statistics about user numbers and patterns to improve services. Assisting people with disabilities with physical operations. Being on hand to recommend further resources based on information about what a user is trying to find or do. Monitoring hygiene and health and safety conditions, such as temperature, and sending through alerts when problems occur or the environment is inhospitable.

-Demonstrating and troubleshooting the use of equipent e.g. photocopiers, scanners, printers etc.; how to connect to wifi using mobiles, troubleshooting laptop issues.

Monitoring / counting workspace use (guiding people to a free workspace / pc)

-Death ray application for annoying patrons.

-With RFID robots could perform stock audits in libraries perhaps?

-Emptying book boxes, and shelving
cleaning the library, picking up litter
Recording criminal activity

-issues with IT, interacting with children

-Retrieving items from storage, counting patrons using spaces,

-To interact with children: perhaps suggesting she appropriate books?

-no

-Carpet cleaning
Selecting books from storage (like the British Library)
Sorting books for re-shelving at the point of return (even if not then directly re-shelved by them)
Locating 'missing' books through the use of data tracking

-Finding items that have been misfiled.

-Shelving, sorting, collecting books, delivering pre-designed training etc

-Online search tools which use machine learning to predict what information people are looking for eg. google and amazon.

Wikibots automatically generating Wikipedia articles

-Rather than a guidance robot to take me to the books, I would prefer a robot that will go and fetch my book and bring it back to me when I've ordered them from a self-service terminal or staff member.

Essentially I would like libraries to structured a bit like Argos - maximising space for comfortable sitting, computers and other services and having robot fetch books from an efficiently organised and almost entirely machine run back-end.

-Cleaning

-Robots to read stories to kids?

-tell you how many computers or study spaces are free (look up online before you go)

-Sorry, no

-Reading to kids

-Cleaning or phone answering

-Cleaning, putting that protective plastic around books.

-Returning, organizing and sorting through returned items (this would greatly reduce wrist injuries for staff)

-Cleaning
Facial recognition to identify people with unpaid fines

-IT support. Help people with disabilities.

-Making tea :)

-In a theoretical situation, we can put on Robot at the entrance/ exit of the library and if some one sneak or forgot to borrow a book, it would smack them on their back. or shouts out 'You have our book. Please check out or return. don't try to steal it from the poor, i.e. us'
that'll be good.

-Checking shelfmark ranges of bays to feed into a shelfmap system and ensure the start and end ranges have not changed; Using rfid tech with a robot to record books in use within the library envelope for better collection management and space usage decision making.

-No

-Self-cleaning toilet (programmed at turns itself on every 5 hours. I think just for loo and sink).
In a massive campus, a GPS inserted on each library card, in order to let the students know where they are if they get lost.

-Help with disabled users, e.g. reading texts for blind people, helping physically disabled people with movement around the library and reaching and carrying materials.

User announcements in emergencies.

Cleaning and dusting libraries.

15. What impact do you think the use of robots for roles traditionally carried out by human library staff would have on the services provided for library users? *

Number of participants: 165
6 (3.6%): Very positive
64 (38.8%): Fairly positive
51 (30.9%): Fairly negative
15 (9.1%): Very negative
4 (2.4%): No impact
25 (15.2%): Don't know

16. Why do you think this?

Number of participants: 131

-Human interaction is a valuable part of libraries and robots are nowhere near emulating this

-Hard to predict whether robots will be seen as a threat or as a great innovation - still so much mystery and wariness

-I think most users wouldn't notice a difference or care.... I do know that having less staff and more robots would give users more privacy, which would probably increase use of things that have stigma associated with them (e.g. romance novels). But I also think that for some, a personal, human touch is important. I know I've been happy to talk to reference librarians in the past.

-I wouldn't want librarians to be made redundant and I appreciate the personal interactions I have with librarians.

-Might simplify certain tasks snd allow library personel to manage exploding volume of information.

-I don't really know how widespread or practical it could be

-I have had quite helpful conversations with robot information lines that have often been more positive than talking to an 'unhelpful' real person.
If robots could undertake mundane tasks it would free up staff time for more involved enquiries.

-I think it depends a lot on what you're talking about. Providing chat services on the internet with a robot could help increase people's use of libraries by providing 24/7 assistance, for example, thus I think would have a very positive impact. But I don't think having a robot in the library to help people find books would be helpful. I work in a elementary school library, and when kids come to the library, they don't want a robot to help them find a book. They want a person to talk to about what they like, and books they've read, and books they might want to read. I would imagine it would be the same in public library settings, especially when people are coming to the library for advice about research,

applying for jobs, etc. I could be biased, but I rate human-to-human information seeking processes very highly, and don't think they could be effectively replaced by a machine. Think about how frustrated people get with automated phone conversations! They always just want to talk to a person.

-I like the human touch, the sense of connectedness that happens with human employees. I also think that even though robots may be great in theory for routine requests, they can never accommodate all of the unique service needs that human employees can. My company is implementing more and more automated systems, and they create almost as many problems as they solve. Programming cannot replicate human experience, and any 'outside the box' requests are handled poorly.

-It could potentially free up library staff to concentrate on more value added activities, spend time increasing their knowledge and focus on being more innovative. This would ultimately lead to a higher level of service for the users.

-because i can see the future

-Mundane jobs can help over stretched staff, but there is a danger that these jobs can also be useful as stress relievers.

-Regardless of whether or not people would rather use a self service machine or a borrow from a human, I think having a purely AI staff would make people (myself included) quite uncomfortable

-It will help to do the most physically tiring or repetitive tasks, so the rest of staff can focus on management, research or other advanced tasks that require critical thinking

-Human contact is essential for mental wellbeing. Manyvpublic library users are very lonely and seeking company more than the library facilities

-It's a human place to learn and robots are not at a stage yet to spot the nuances in human behaviour

-Resources are limited so the use of automation for borrowing books has presumably helped to keep public libraries open. However, I think this works in my local library because there are still helpful human staff available to assist and provide social contact for those users who need that as much as a book/ information

-It changes the atmosphere of the library from expert lead to machine serviced. People care, are flexible and can empathise whereas robots are none of those and can not offer a positive regard and interacton and they don't convey or create a workspace culture that is good for staff and costumers. If well designed it can be inobtrusive at best. Mundane tasks like shelving and sorting might be helped by robots, but still require human input as the books need evaluation for repairs and machines are always glitchy.

-Be good as long as offers better service Alalongside staff, assisting not replacing staff

-Because you often find out things you might not have thought to ask in the course of conversation. Because it gives jobs to people who develop and learn and acquire knowledge about collections. Because robots don't smile at you

-most people the job is more important than the person carrying it out

-I don't think robots are advanced enough to really answer questions or interact with people. Also, it does take jobs from people who can do them better, and allows companies to further erode worker's rights by threatening to replace workers with machines. Finally, libraries have a huge value add for people like the elderly, single mothers and the homeless who can go to have a warm social interaction and that atmosphere should be preserved.

-Councils are struggling to keep libraries open so it might help

-People are scared of what they do not know and don't like change.

-Removes some of the mundane tasks and allows staff to focus on other more important work and projects

-I like personal interaction

-I imagine they would continue to be as good if not better.

-It would keep the library organized and make locating books, resources, etc. an easier / faster / more precise process. However, not having as many humans around could lead to frustration if you have an issue that cannot be solved easily by a robot.

-Loss of knowledge and advice that comes from real staff.

-Efficiency improved

-Staff can engage more with the elements of the job which require emotional engagement and subjectivity rather than the monotonousness of some of the tasks today

-Ruin the atmosphere of the library. And also...if I want help I want to talk to a person, not a robot who is going to drone on and on and constantly ask me to repeat my question because he can't understand my accent

-Particularly for enquiries you need someone to interpret the question and work out how to point someone in the right direction. A robot can't always work out what people are asking

-In my opinion, knowledge is social. Epistemologies are socially constructed, ratified and sometimes fiercely contested. Given this, the process by which you gain knowledge can be as valuable as what you learn. It should leave space for negative capability, ambiguity, paradox. The search for knowledge should be a quest, and a bit of a mess.

I could be wrong, but I still feel as though robots are designed with the aim of curtailing, or eliminating, as far as possible, that 'questing' . A librarian can send you off on interesting tangents, encourage you to make connections, explore parallel texts, recommend a philosopher whose work might illuminate the reading of a particular text. A robot aims to provide you with the facts, decontextualised, as though plucked out of thin air. It makes an outcome appear inevitable, teleological. It makes questions into a question and answers into a fact. That I fell, is a loss, particularly at a time when leaning is becoming more utilitarian, responsive to the financial crisis and the creativity-sapping employment market.

Then again, I'm writing as someone for whom searching for an elusive book in the overflow tacks of the library's basement was the world's best treasure hunt.

-I think people who still use libraries would be put off by the use of robots instead of people and would possibly begin to avoid the library if a human librarian wasn't an option. People still avoid self service checkouts in supermarkets and I think it would be the same for libraries and if the human element had been removed completely people may start avoiding the library completely. Granted this wouldn't be true for all people but I think it would be enough that it would have a fairly negative impact.

-Efficiency.

-If the robot was advanced enough, it should make things faster and simpler for library users. It does run the risk of becoming finnicky and annoying though, much like a self service checkout. When they are working properly its efficient and fast, when they are even slightly wrong it becomes annoying, tedious and pointless.

-Because robots could perform a variety of tasks to support human workers. Time-consuming and routine jobs could be taken over by robots and free up time for human staff to do above and beyond tasks, improving the library more generally and the user experience. In my experience there is often a lot of demand for human assistance in libraries and there isn't always some available. The support of robots could change this.

-Human librarians have more time for other things, robots do physical tasks librarians are available to speak to users
Some loss of jobs so not entirely positive

-Because human library staff are not only skilled workers, who are able to assist with library queries, but also are important for a library environment to genuinely be open and accessible to all, including vulnerable members of society. I think whilst robots may be able to go some way to replace or assist with the former, the can't do the latter.

-Fairly negative because it would take away the warm inclusive nature of a library and make it more clinical and controlled.

-Ridiculous. People are sufficient for the jobs not robots

-We need real interactions and thinkers

-Because it is important to have a human person to assist, technology is useful as an extra, but cannot replace a human

-Cuz there hands would be all mettaly n shit

-certain roles that do not require human staff could be made more efficient and be carried out 24/7

-Libraries already struggling. May reduce jobs in this area. Also library staff have expertise it would be difficult to get robots to do as quality a job

-I would say that robots cannot replace human interaction, especially when talking about books, but my library is in the same building as the council offices and so their staff cross over. They don't seem to care much about books at all, so I don't feel I'm missing much by solely using automated library services. If I had a more engaged local library, I am certain that I would be more ambivalent about automation.

-I think robots would be more accurate and efficient at the sorting and storing aspects

If databases are immense then the amount of cross referencing available could be immense.

-No customer service

-Human interaction is the essence of library resources. There are subtle nuances to enquiries made which a robot would not be able to detect.

-Both staff and users value human interaction. I might find it quicker to use a machine to check books in and out, but I still like to chat to the staff.

-If it helps keep costs down and libraries open I'm all in

-I think a lot depends on how and why robots are deployed, and the political economy under which this happens. I don't think library work is particularly onerous or unpleasant; under a regime when people are left impoverished if they can't work, the removal of these jobs should be approached with caution. In a better situation, this could free people to pursue other endeavours, either within the library (focussing more on supporting people's research, helping with difficult queries) or in life more widely.

There are some functions where it might be better having a human in place. I recall reading a chapter about librarians as a keystone species in a book titled (I think) Information Ecologies. E.g. in help searching for resources where the person looking for something doesn't have a clue about the right search terms or is not adept in using the system. It would seem to indicate there would be some role for human librarians for the foreseeable.

-You dont go to the library for the staff (unless your mr bean). You go for the resource

-Haven't thought about it

-Personally, I like human interaction.

-Installation and maintenance costs of automated services are probably higher than human labour costs to little benefit in terms of speed of service. Digitised media and reduced reliance on library services would have a greater impact.

-could be more efficient

-Library staff can sometimes come across as rude, probably because they want you to bugger off and shut up most of the time. Robots are all friendly and nice. Note my earlier answer stating that I've never used a library, so all of my opinions are based on film and TV.

-Robots seem most likely to be employed to improve the use experience rather than Twitter existing staff, so the experience is unlikely to get worse. Oh course, I've been wrong before...

-There are some interactions that could feasibly be made more efficient by using robots however personally I prefer to speak to another person. I also would be more frustrated if there was an issue with understanding between a myself and a robot than I would be with another person. I also think that whilst some uncomplicated tasks could be completed successfully by a robot complex enquiries or recommendations would still be better quality from humans

-If it makes running libraries cheaper and keeps more of them open for more hours, this is undoubtedly a good thing. However having fewer humans in the building to talk to about books would be a loss, so I can't be too emphatic with my positivity.

-One of the most important things about libraries is the human contact/conversation, particularly in local libraries where this contact may be the only interaction some people will have that day. I don't know if this is really what you mean by robots but already the use of automated issuing machines is reducing this contact. I find it handy to use automated issuing machines but I don't like that in many public libraries using the issue desk is actively discouraged. There is a place and a need for both I would say.

-Library users will always appreciate more efficiency and help when it comes to their needs. Robots could provide that.

-People automation that makes their lives easier, but taking away the human element isn't necessary. A balance is key.

-I think most people are looking for efficiency nowadays, if they get the service they want when they want it. They don't necessarily mind how it is delivered.

-So many jobs are done by machines successfully in other fields.

-I think the impact of using robots mundane, repetitive tasks, thereby in theory either saving money or freeing up staff to help users in other ways or doing tasks more accurately should be positive. But it's hard to tell what impact it would have: for instance if shelvers were replaced users would have to always go to help points (typically near the library entrance) for help instead of being able to ask probably knowledgeable shelvers. I suppose what I mean is, humans can multitask: shelve, answer a simple query, direct a user to the emergency exit, be asked for a book and say 'that one's good but this one's better, I think we're on the same course, my name's x by the way, let's go for a coffee when you've finished working in the library'... though reading that back, I think some people would prefer the robot!

-I just think that human customer service is famously bad in London. So self service is a way to avoid rude people.

-I think that the human face of the librarian is very important as it allows users to feel welcome and to ask questions that they may not feel comfortable asking a robot. Also, apart from directional queries (where the toilets are or where a book is kept on a shelf) which robots can do easily, they cannot conduct a proper reference query - really probing. And even if they could, the user would soon get tired of pushing various buttons to move the interrogation forward. The eye-contact, the nodding, making the user feel comfortable about asking what the user deems to be a 'stupid question' cannot be replaced by a machine. Further, tips on evaluating information found, the critical literacy skills that are developed by the user by seeing examples and the information literacy teaching that is provided by librarians cannot be replaced by a robot.

-I value inter-personal & human interaction and think that customer services is absolutely essential in any academic Libraries. I also would feel that robots would be a noisy disruption to the Library environment. I'm also aware that potentially robots would regularly breakdown, be damaged, get hacked or reprogrammed by external parties.

-If we replace service industries with robots, we will be losing a lot of jobs; mundane jobs yes; perhaps jobs not fit for humans. If other jobs were created in their place that celebrated human interaction, with an extra emphasis on group activity and social interaction then perhaps automation might work very well. However, in our current austerity climate I suspect that the roles would not be replaced, and would create a lot of frustration and alienation,

-Lack of human interaction

-Many of the jobs in a library are either repetitive or physical, and over-exertion by shelvers, for example, often leads to RSI and other physical injuries. I think static help points (as opposed to humanoid robots, which could prompt robophobia) or online chatbots would be useful for users asking the kinds of questions human assistants answer 1,000 times, per day.

-People like to ask a human - we all need interaction. If people were told off by a robot for noise they would take no notice.

-I feel like robots in a library sort of sets a weird tone.

-It will be good for people who struggle with talking to people - shy, anxious etc.

For people that lack friends, it would be a shame for them not to have the human contact.

It should mean that books are where they should be!

-A robot can have knowledge and assist you but there would be very miminal interaction with humans and algorithms used by robots may not entirely help people find suitable recommendations or assistance like a human would.

-Though there will be an economic driver behind increasing automation (people are getting more expensive while robots getting cheaper), and I do think robots / automation could foreseeably perform some roles better than humans, I think that on balance they would lessen the library as a social space at a time when colloboration and social activities are becoming more embedded in learning and that though this would lead to a 24/7 (always open) library, and possibly allow student fees to be used for other things of benefit, I think the library as a sapce would become more factory-ised.

-There needs to be some human interaction with real people who have (a) accrued experience and knowledge of unforeseen circumstances and eventualitiies (e.g. locating a book that has been mis-shelved but using experience to work out where it may have been shelved instead and (b) who have human emotions and are therefore able to offer empathy and to defuse potentially difficulat and upsetting situations.

I can see a role for robots to fetch and return RFID'd books from closed shelving areas, but - as mentioned above - I am doubtful whether a robot would be able to locate misshelved books as well as humans. If the general fetching/reshelving duties are handed over to robots, human stafff will over time lose familiarity with a large library and its shelving / classification idiosyncracies, and will therefore become less and less able to assist in situations where human knowedge is required

-Library users want the human interaction, and most of the queries people have are relatively complex - too complex for a robot to be able to give the correct information. This would lead to feelings of frustration from the users. Robots could be useful in some tasks, e.g. shelving, but not the more customer facing roles, imo.

-Nothing can beat a human touch/interaction!

-Society is moving in the direct of more automation and as budgets are squeezed there has to be a viable alternative. I think it may also encourage younger users to the library as my experience of library staff has found them difficult and not very child friendly.

-I don't think anything could ever completely replace a human face.

-think people using libraries in person would prefer to speak to a human, the more technological among us would maybe not use libraries in person and would meet their requirements online

-I think human interaction with other humans is important and that life isn't just about functionality; however capable robots are or will be, some level of human involvement in library services matters.

-I can see robots could provide more ready information, perhaps late at night or on-line. However, I associate libraries with people, and would still want the human touch to be evident in libraries - ie someone I can talk to, a security guard to keep me safe etc

-Lack of social human interaction. Lack of relationships

-It is likely to cause a change in how libraries function and changing the traditional roles librarians have had, which can be seen as positive as well as negative depending on your perspective.

-I think all robots have limitations as they are programmed and may not cover people's needs. I don't think they can cover all circumstances. What would they do if someone becomes unwell, for example?

I think personal contact is always preferable to a machine but that is maybe to do with my age.

-Frees time for library staff to work on other tasks not currently given priority (outreach, community work, education, research, etc)

-I prefer a human being

-There would be some staff required for things the robot couldn't do but if I were library staff I would be worried my skills would need to extend to maintenance etc.

-Some library users appreciate the human contact they get there

-It would take some adjustment and people don't like change, which would be why it would not be 'very positive', however with new systems in place then human staff could focus on the tasks that robots cannot do - with the big things done then the details can be better taken care of.

-My worry with the introduction of robots into front-facing roles is that people who need human interactions - particularly the case in public libraries - will not get them, and will be missing out on an important social interaction. On the other hand, as libraries become more understaffed, having robots to carry out tasks may actually improve the overall service of the library, and allow them to remain open - for longer hours, in the case of academic libraries, or maybe at all, in the case of public libraries.

Currently no AI is capable of the creative leaps of logic that libraries sometimes need to help library users. But menial tasks, such as shelving and fetching books, could probably be performed better by robots. This would also allow for books to be stacked in ways that are undesirable for human librarians - ie on very tall or low shelves - as it would not be damaging or inconvenient to robots to work with these shelves. This may be very useful as libraries try to conform to new and additional demands on their space.

-Faster providing enough robots provided.
Releases staff for higher level activity including advice and support and research.

-Could do repetitive tasks quickly and efficiently. May allow cost savings.

-Impersonal sterile unfriendly

-It may have a positive effect in terms of speed and efficiency of service - finding information and processing basic transactions more quickly and conveniently, and free up staff time to deal with other activities - complex enquiries or outreach activities.

If used as a direct replacement for library staff, there is the risk of eroding staff knowledge and expertise, and de-personalising the experience of using libraries. Older library users in particular may feel threatened or marginalised by an over-reliance on robots.

-24 hour help available. Library staff would be able to carry out more complex tasks while robotics covered issuing items/returns/shelving etc.

-I think they could have a very positive effect if utilized in an effective way that means the robots are fulfilling functions with minimal complex human interfacing.

I think the concept of humans and autonomous robots working side by side in perfect harmony doesn't work very well (at least at the moment).

I think it makes more sense to have the machines to work efficiently without human interfacing as an obstacle in a separate space as much as possible.

If they are in separate spaces, less attention has to be paid to 'how will people feel about seeing/communicating/moving in the same space as this robot' and the robots can be optimized to complete tasks as efficiently as possible.

-I find it unlikely they would be able to substitute real human advice/service but could easily undertake searching/organising/cleaning task

-The tasks mentioned in the previous slide could be done by robots. You're not in a library to talk to people and I think library workers could be in jeopardy

-Allow library staff to undertake a higher level of work

-It would make it less personable.

-I don't know if people would prefer the personal touch a bit more from another human, as opposed to a robot.
In my opinion, some people love to chat to the library staff and I think that this is an element that would definitely be lost.

Also, would this mean that some people would lose their jobs, if robots replaced them? That's definitely not an ideal situation.

What happens when a robot breaks down/malfunctions half way through the day, what happens then? Will there still be humans around to fill in, whilst the robot is being fixed?

I'm on the fence on this one. You just don't know how things would pan out.

-Could be seen as a novel way to get people back into libraries and ultimately reading.... or at least i hope

-It is about people losing jobs in favour of robots. Potentially the robot can be more efficient - but I'd only really be in favour if the human resource was redeployed - doing other, non-robotic tasks

-There will always be a need for humans. A robot can't understand nuance or cultural references.

-I think people prefer to interact with people when asking questions or getting help, so if robots replaced people in all of the ways mentioned in previous questions it might put people off using them, and thus my get as much out of using the library. Robots to do things like checking books out, returning books to shelves etc though I think could free up staff to answer queries etc, which would be a positive.

-It would save money and time, but i think it's important to keep human involvement in some way so it still feels like a service with personality

-I can't speak for other people. While I might be fine with it, others might not. People are crazy. The focus is on robots, but they follow programming. AI is an altogether different beast. Robots replacing menial labour is one thing, but role accepting a machine in interpersonal transactions is entirely another.

-A lot of patrons, especially in community libraries are in the senior demographic and go to libraries to socialize with the staff.

-a smoother service

-If they work well, then they should be a benefit to users. Great care must be taken when trying to turn a 'human' environment to a more 'automatic' environment where people can self serve. It needs to work seamlessly and in harmony with real staff. Being a help, not a hindrance. There will always be people who want to speak to a person face to face.

-Uncertainty about what is the correct question to ask sometimes if it is about a science paper or question or you aren't sure what data to put into computer to ask it.

-Some people enjoy human interaction

-It's been positive for some types of customers and negative for others. Every customer requires different services and so offering both options is the best outcome for everyone.

-I think robots could carry of the functional aspects of certain library jobs as well as humans but I believe there is potential danger in losing the 'human touch' and being able to speak to a human being about their feelings about a certain book, how their day is going,etc

-I think it would be good if they helped people

-We as human beings are social animals and need to interact with each other. While there may be some tasks that robots can do -it may be at the expense of people's jobs and social isolation of the library user.

-First of all, it'll be mechanic without any human touch. the other reason would be no jobs for human beings. Lastly, if the server down or their battery charge is running down or low, what will happen.

-Because it would remove the need for us to focus on basic routine tasks which would allow us to deploy our staffing to deal with more advanced or specialised tasks which require more complex judgements or decision making which machines are not able to do well.

-People are better at interacting with people because they are flexible and can change behaviour/ approach to meet changing needs of a user. Sometimes users are upset /unhappy /stressed and library staff can help them. Their needs may be beyond wanting a book/article etc. Do not thing that an interaction with a robot would be as useful or comforting. Can see a use for robots to provide directions/ advice on commonly asked questions ie where is the toilet/ how does the photocopier work. Do not think a robot security guard would make me feel safe.

-It depends on the role. I think at the enquiries desk the impact might be a bit negative in the first instance. Who would love to talk to a robot rather than a human creature who can understand instantly your feelings? Even if you are just looking for the exit but you feel lost or you have to report that you have lost a quite expensive book.
About cataloguing books and other materials, the process partially has already started, I don't think the impact would be so traumatic.

-As most libraries have experienced a reduction in library staff and more computerisation of basic tasks, being able to supply extra support services with robots should be beneficial to users. Also, a number of public libraries are faced with threats of closure or a reduction in services, so if these could be reversed by the use of robots, it would be positive for users.

-1) The use of robots dehumanises humans. It humiliates them. It alienates them.
2) Robots and computers will be misused to put humans under total surveillance.
2) Robots combined with artificial intelligence can endanger humans directly.

-One fundamental reason why many people use libraries (especially public libraries) is the human interaction with the library staff. Also, many people, especially older age population, would require training to understand and be able to use or engage with robots or similar technology.

-It would lead to job losses

17. Are you currently working in a library (paid or voluntary)? *

Number of participants: 165
41 (24.8%): Yes
124 (75.2%): No (Routed directly to question 20)

18. Which type(s) of library do you currently work in? *

Number of participants: 41
33 (80 .5%): Academic/research
2 (4 .9%): Public
3 (7.3%): School
2 (4 .9%): Law
0 (0.0 %): Medical
1 (2.4 %): Other
Answer(s) from the additional field:
- Business

19. Would you be willing to take part in some follow-up research?

Number of participants: 39
18 (4 6.2%): Yes (please contact me at david.phillips@city.ac.uk for more details)
21 (53.8%): No

20. What is your age? *

Number of participants: 165
0 (0.0 %): 17 or younger
0 (0.0 %): 18-20
60 (36.4 %): 21-29
4 6 (27.9%): 30 -39
16 (9.7%): 4 0 -4 9
20 (12.1%): 50 -59
19 (11.5%): 60 or older
4 (2.4 %): Prefer not to say

21. What is your gender? *

Number of participants: 165
100 (60.6%): Female
59 (35.8%): Male
4 (2.4 %): Prefer not to say
2 (1.2%): Prefer to self-describe
Answer(s) from the additional field:
- Ecto cock lizard
- protocol droid

22. In what country do you currently reside? *

Number of participants: 165
143 (86.7%): United Kingdom
22 (13.3%): Other
Answer(s) from the additional field:
- USA
- United States of America
- United States of America
- United States
- Hungary
- Republic of the Congo
- Jordan
- Cambodia
- Jamaca
- US
- Guyana south America
- New zealand
- Australia
- Australia
- Australia
- Japan
- USA
- Spain
- New Zealand
- United States
- New Zealand
- New Zealand

Focus Group Discussion Guide (used by moderator)

AUTOMATION AND ROBOTS DISCUSSION GUIDE (23/11/16)

Introductions (5 mins) 17.15

- Thanks for coming, help yourself to food and drink
- Explain purpose of the research is to build on the survey they all completed
- Want to hear their opinions as library staff
- No right or wrong answers
- Will be recorded, but your feedback will not be relayed using your names
- Will take around an hour
- I know we all know each other, but for the sake of the recorder, could you please go around and tell me your name and your role at the IOE

Technological advances in the library (15 mina) 17.20

- Changes they have experienced since working in libraries (not just in the IOE)
    - Which new technologies have they seen?
    - How has this impacted on their work?
    - Do they think this has had a positive or negative impact on **library staff**?
    - And how do they think this has impacted **library users**?
- If not mentioned spontaneously, probe:
    - How about self-service?
    - How about RFID?
        - Impact?
- Do you think technology is currently being used to its full potential in libraries?
    - If not mentioned, probe for other uses of RFID (stock control, sorting etc.)

General attitudes towards robots (10 mias) 17.35

- As you know from the survey, my research is looking at Robots and Artificial Intelligence, particularly their current and potential roles in libraries
    - For the purpose of this discussion I would like you to think of robots as:
        - *A machine which can assist humans in everyday tasks without constant guidance or instruction, e.g. as a kind of co-worker helping on the factory floor or as a robot cleaner, or in activities which may be dangerous for humans like search and rescue in disasters. Robots can come in many shapes or sizes, and some may be of human appearance. Traditional kitchen appliances such as a blender or a coffee maker are not considered as robots.* **[SHOW ON SLIDE]**

- What do you think of this definition?
    - Is this what you think of as a 'robot'?
- Generally, how do you feel about the prospect of robots/AI becoming more present in society?

Comfort with robots and AI in the library (15 mins) 17.45

- I would like to give you some examples of potential uses for robots in the library, which you may remember seeing in the online survey:
    - A robot 'security guard' that would patrol the library (e.g. to monitor for noise disruptions and other issues with the library environment)
    - A robot 'shelver' that would be able to identify and locate different library items and physically return them to their correct locations
    - An online 'library chatbot' available 24/7, that would answer basic enquiries about the library (e.g. providing opening hours, directions, basic library account information etc.)
    - An online 'library chatbot' available 24/7, that would provide an advanced enquiry service (e.g. guidance on search methods, accessing digital databases, evaluating sources etc.)
    - A robot 'assistant' that would help you find your way around the library (e.g. physically leading you to items on the shelves)
        - **IN TWO GROUPS:** ask to rank by moving the cards: most comfortable at the top, least comfortable at the bottom **[IN THIS LIBRARY – THE IOE]**
            - *From the perspective of a library worker*
- **AS A GROUP** - Discuss:
    - Why are they more comfortable with some examples?
    - Why are they less comfortable with some examples?

Real life examples of robots and thoughts for the future (10 mins) 18.00

- I would now like to show you some real life examples of robots in the library
    - **SHOW EXAMPLES ON SLIDES:**
        - BL robotic cranes/automated storage system
        - Bob the security guard
        - Hugh the voice controlled AI robot
        - Xiaotu the smart talking robot
        - AuRoSS the autonomous robotic shelf scanning system
        - When robots join the library
- What do you think of these examples?
    - How do they make you feel?
    - Which did you particularly like – why?
- Do you have any opinions on how these robots are described?
    - **PROBE:** 'shelver', 'guard' etc, versus an acronym/human name
- Do you feel differently about them when you see them implemented in real life?
    - How does this make you feel about the future of library work?
- Can you think of any other ways robots or AI could be used to improve:
        - Staff experience
        - Customer experience

Thanks and close! 18.10

- Anything anyone would like to add?
- Any questions?

Focus Group Slides (shown to participants)

Automation and Robots Focus Group with UCL Institute of Education Library staff

Wednesday November 23rd 2016

Research as part of a dissertation project for MSc in Library Science at City University

David Phillips
david.phillips@city.ac.uk

What is a robot?

"A machine which can assist humans in everyday tasks without constant guidance or instruction, e.g. as a kind of co-worker helping on the factory floor or as a robot cleaner, or in activities which may be dangerous for humans like search and rescue in disasters. Robots can come in many shapes or sizes, and some may be of human appearance. Traditional kitchen appliances such as a blender or a coffee maker are not considered as robots."

A robot 'security guard' that would patrol the library (e.g. to monitor for noise disruptions and other issues with the library environment)

A robot 'shelver' that would be able to identify and locate different library items and physically return them to their correct locations

An online 'library chatbot' available 24/7, that would answer basic enquiries about the library (e.g. providing opening hours, directions, basic library account information etc.)

A robot 'assistant' that would help you find your way around the library (e.g. physically leading you to items on the shelves)

An online 'library chatbot' available 24/7, that would provide an advanced enquiry service (e.g. guidance on search methods, accessing digital resources, evaluating sources etc.)

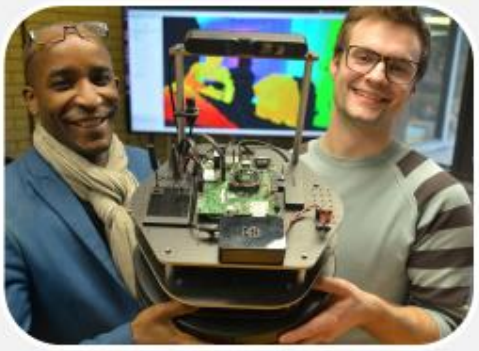
Robotic cranes/automated storage system - British Library, Boston Spa

Image source: http://gizmodo.com/the-giant-robots-that-serve-the-worlds-largest-library-1700712936

AuRoSS (autonomous robotic shelf scanning system) – Singapore National Library Board

Image source: http://lj.libraryjournal.com/2016/08/industry-news/high-tech-shelf-help-singapores-library-robot/

Hugh the 'voice controlled artificially intelligent robot' – Aberystwyth University



Pasi Chidziva, also known as William Sachiti (left) and Ariel Ladegaard (right) with a prototype of Hugh, the robot librarian.

Image source: http://lj.libraryjournal.com/2016/03/technology/library-robot-coming-to-welsh-university/

Bob the 'robotic security guard' – University of Birmingham

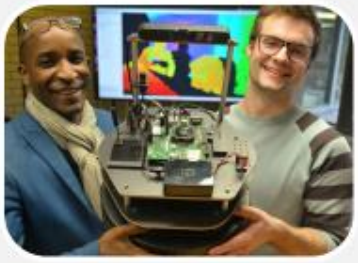
Image source: http://thetab.com/uk/birmingham/2014/11/24/meet-bob-library-robot-15102

Xiaotu the 'smart talking robot' – Tsinghua University

Image source: Fei Yao, Chengyu Zhang, Wu Chen, (2015) "Smart talking robot Xiaotu: participatory library service based on artificial intelligence", Library Hi Tech, 33:2 pp. 245 – 260. DOI: http://dx.doi.org/10.1108/LHT-02-2015-0010

Vincent and Nancy – Westport Public Library

Source: https://www.youtube.com/watch?v=J_KRDqtZwQ0



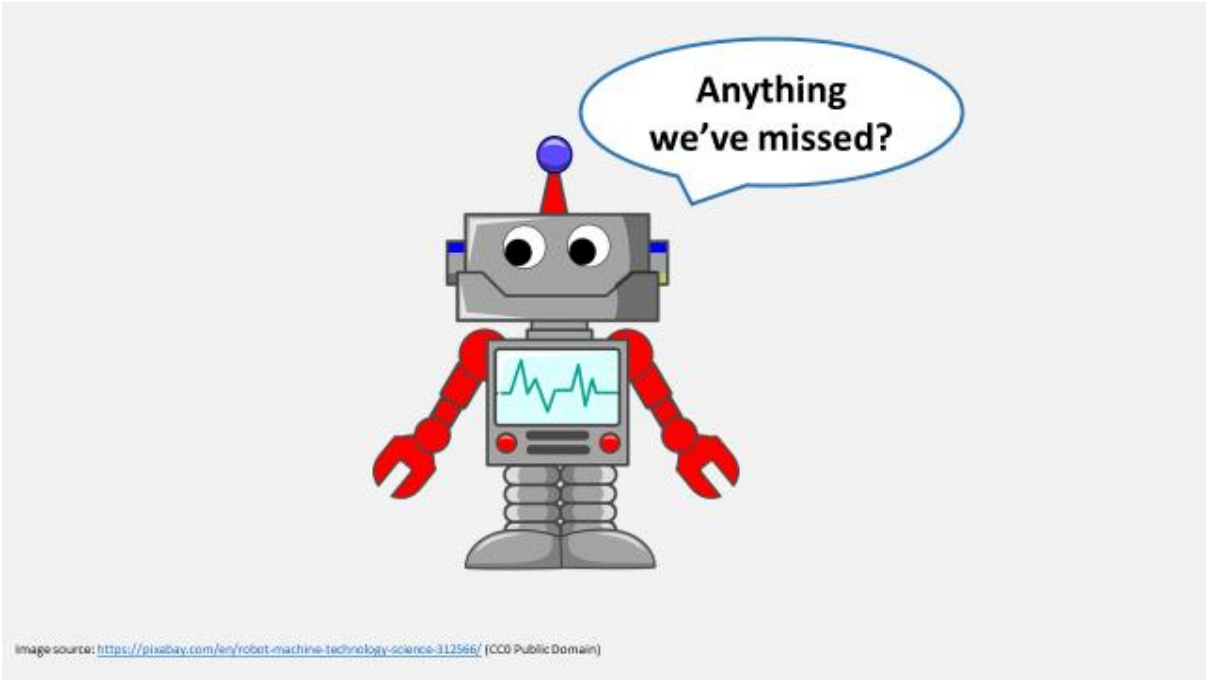


Image source: https://pixabay.com/en/robot-machine-technology-science-312566/ (CC0 Public Domain)

Focus Group Transcript

Moderated by David Phillips (D)

Participants' names have been redacted but each has been given a number.

Intro - (0.00)

D: Thank you all for coming, I appreciate it. Like I said in the email this is going to be a follow-up to the survey you all completed before, so we're just building on that and especially wanting to hear your opinions as library staff. The survey had questions based on library use, but I want your expert opinion, if you like, as library staff. Some of the things we're talking about are going to be quite hypothetical, all your opinions are valid, there's no right or wrong answers so you don't need to be experts on robots or anything like that. Like I said I am recording, and like I said in the email the feedback you give and the opinions you give aren't going to be relayed using your names when I actually write it up, so it's all confidential. We'll go for around an hour so hopefully we'll finish in an hour's time. I think just to get started, I know it's a bit weird because we all know each other, but if we could just go around and say your name and what your role is at the IOE so I'd say 'I'm David, and I'm a Library Assistant in User Services.''

1: I'm [redacted], and I'm a Library Assistant in Collection Development.

2: I'm [redacted], and I'm the Research Support and Special Collections Librarian.

3: I'm [redacted] and I'm an alcoholic. That's the other meeting.

(Laughter)

3: I'm [redacted] and I'm the Librarian here at the IOE.

4: I'm [redacted], I'm the Issue Counter and Membership Desk Supervisor.

5: I'm [redacted] and I'm a Cataloguing Librarian.

Technological advances in the library - (01.46)

D: Ok thank you very much, so the first subject we're going to talk about is thinking back on the time you've worked in libraries, going back as far as you like, and it doesn't just have to be at the IOE, any libraries you've worked in, I just want you to think about some of the big technological changes you've seen and how that's impacted on your work in libraries. So any examples of those changes that you've seen…

1: I can remember Browne Card, Brown Card issue system.

2: Me too

1: Until I came here, which is my third library job, it's the first automatic computerised library system I'd come across, so I don't think brown card would work in such a large library with so many users and they're allowed to take quite a large number of books out. I don't think it would work, so being

able to have a computerised library system suits the large library. I can still see it working on small libraries, or libraries where they have no power or a very intermittent power source.

D: Ok, but you think because it takes longer for staff to process those items…

1: Yes, and if you have a system where your user has a brown card for each book they are able to take out, so either they keep them all, or you keep them all, so it takes up an awful lot of room. Can you imagine each one having twenty-odd, thirty-odd cards - it's not feasible.

5. I was actually, my last place of work, I had to implement circulation, automated circulation system there. So before that we had just paper-based system, card-based system for loans. So I went through that process, and I think I remember that before we changed there was an awful lot of intense staff time just admin for sending out the notices. That was the biggest thing, just figuring out what notices had to go out and sending them all out which all became done, obviously got done as part of - it was an Oxford Library so we got the package from central. We had to jiggle with it to make it fit our context, but once we'd done that it was so much quicker and easier once that circulation system was in. I do remember that, I remember we were wondering how it would work and how it would affect the workflow 'cause you think of all the problems it might create but you don't think of it...the time saving was massive.

D: Ok, so it was seen as a generally positive thing, or a negative thing?

5: I don't remember any negativity about it. We wondered what impact it would have but it just reduced the mundane tasks of sending out the slips.

D: And what about for the users, do you think it made their lives easier or was it more about the staff?

5: I was only really aware of the staff, it wasn't one of those projects where we did a big user survey and afterwards found out how it had affected them. It was just this is being implemented across Oxford Libraries and do you want to do it? We applied to do it so it was of obvious benefit 'cause people could manage their accounts themselves, before it was in a filing cabinet with people's' cards, so it was also better for them, it linked in with circulation from other libraries, you could have books come in from other libraries as well.

D: (To group) Any other examples?

2: I was just thinking, you guys are talking about this and I'm clearing the cobwebs here, but when I was in Canada we moved from a microfiche catalogue to an online catalogue, and that was a major step and that was in a music library, and it just didn't work in the online 'cause you had what you call uniform titles for music. .So in terms of the catalogue, you know, the most important thing for a music library is the Kochel number or the BWV number for Bach, a piece of Bach work or whatever, and suddenly with the online they'd forgotten to put the uniform title in, so there were lots of symphonies and oratorios and all that, but you just couldn't work out which one it was 'cause there'd be lots of stuff in c-minor or c-major or whatever. So it was a major disruption in terms of users so we had to keep referring back to the microfiche catalogue until that had sorted, so my first job was to create a guide.

3. Was it a LibGuide?

(Laughter)

2: It was a Library Guide.

3: Library Guide 1987

2: On a piece of orange paper , I still remember that, instructing users on how to use this library catalogue, and it was actually using subject headings, so Library of Congress Subject Headings. But, you know, in terms of cataloguing we had been cataloguing online and downloading records, 'cause I used to do sound recordings cataloguing, and we'd been downloading sound recordings, you know the kind of bibliographic information from the New York Public Library and the Library of Congress and all that, it was all just being streamed into our systems, and then we were just selecting the appropriate content. So it's funny because I had that experience and then I came to the UK and it was the first time I'd ever seen the brown system, and it was like going back in time, for me it was like wow is this what libraries were like before because I'd always worked with automated systems.

3: Well that's where we're going back to with Brexit

(Laughter)

3: In a couple of years you'll see them again.

1: And nobody will know how to use them and we've got rid of all of our catalogue

(Laughter)

2: The cards are gone that's right.

1: Even in Kent Public Libraries when I used to be a regular user, my branch was computerised, the main Reference Library for the whole of Kent was still on brown card. It was a main non-fiction library still on brown card, and again in...sorry that was in Sussex, and again in Kent recently we still had some of the small branch libraries were running on brown card.

D: Really, how recently?

1: Errm, 7 or 8 years, definitely within the past 10, and they for instance even the library in Gravesend which is a major one and when they shut to repair, and they just took the opportunity to put all the tags in the books to have automatic issue systems.

D: RFID?

1: Yeah some of all the small branches, so like I said it was difficult, you'd have books which you could only take back to that particular little branch whereas if the whole system was automated you can borrow a book from one branch and take it back to another branch.

3: Except if it's UCL.

(Laughter)

1: Oh dear, ok. And then they had a van system of course that would take books from one library back to another, but, the very small library in the hospital ran on brown card, which it could do

‘cause we only had about four trays. The major problem was, you dropped one on the floor, (laughs).

5: They call it migration now.

(Laughter)

1: So, as a point of being a library user as well as working in libraries, having a completely computerised issue system really does make life much easier. A catalogue is another thing because some of them are appalling, some of the online catalogues out there, whichever model, some are very good and some are horrible. They’re very un-user-friendly, well un-user-friendly for this user.

3: One of the biggest things that’s happened in my career obviously is the internet.

(Group agrees)

3: Being a systems librarian when I started in ‘99 I was looking at CD-ROM towers, remember that?

(Group agrees)

3: So all your electronic resources were on these CD-ROM towers and you had to install them and update them, and there was this whole visiting a room on its own and clattering along the fans, and it was only networked to the library so you’d have like 3 PCs somewhere down and that’s where you’d...and of course when the internet really took off, of course we’ve got all the e-resources and you’ve got the distance learners. That’s a massive technological, that’s the biggest technological change really isn’t it, being able to access resources from outside the building.

1: I bet you didn’t have dial-up modems.

3: That was before my time but I know they had that. They were earlier adopters of technology libraries were actually weren’t they? One of the earliest users of the internet.

1: We would, being a hospital librarian, many of us were just one-man bands so we used to have regional meetings and we’d have some topic or something we’d be learning about, great excitement someone was coming to demonstrate the web! And they’d sit there and go ‘oh dear’ and I don’t think any of the demonstrations I went to ever worked. So there was this wonderful thing out there, everybody was talking about it this saying ‘oh it’s going to make life really simple’ but it didn’t work.

D: Because it didn’t connect?

3: There was something about time zones, was it at midday because of the time zone difference?

2: Before midday

3: It was before midday, because then all the Americans would wake up and they’d start using it so all the capacity’d be gone. So you had to do all your searches, and you did mediated searches as well on this didn’t you.

2: Yes that’s right.

3: On behalf of users. They'd put in a sheet and say 'this is what I want' and you'd do the search on dial-up with this little bit of internet and send the result back to them, so that's a totally different way of doing things than now, where people do a lot of their own stuff and then ask us for help sometimes.

2: That's right, but you know not everybody, not every subject was represented, 'cause I was studying music and I remember having to do my music essays and it was like, music index would go back to about 1860 onwards, and if I wanted to do research on a particular topic it was like going through every single volume. That would take half a day.

3: Yeah I remember doing that.

1: All my university stuff was hard copy indexes.

3: Physical indexes of things, volumes that you look up something then you go and retrieve what you needed.

1: If you were lucky there was an annual index, so you didn't have to look up 12 issues for each year.

2: It's usually the annual.

1: In my first job I was teaching nursing students to use the hard copy nursing indexes.

3: BioMed

2: It's all before your time David.

D: I remember dial-up.

(Laughter)

1: I won't tell you how the School of Geography at Oxford, how their indexing for their journals...large punch cards, like punch cards like this, A4 size, and you'd have one for rivers, one for South America, one for whatever, so you'd have the holes. And they'd get a wire and go...and all the cards that came up, those were the journal articles on rivers in South America. (Laughter) This was in 1980, this was the School of Geography in Oxford, for indexing their journals.

4: I worked at the National Sound Archive and the Library was automated already, but we didn't have any users because I was working in the Acquisitions Department, even though we were not buying anything we were just receiving from major music companies.

D: Donations?

4: Yes, donations. And the only thing, because I worked here since 2000 I saw big changes with our system. When I joined the IOE we just moved from Libertas, which was like DOS

3: Command line

4: Yeah exactly, I was lucky to actually move when they were doing all the move, so we used it a little bit for a few things that didn't transfer to WebCat.

3: Did you go to SirsiDynix from that, from Libertas?

4: Yeah, but that was actually Peter Moss at the time that was really involved with this but he kind of kept everything...but it was an improvement for the staff for sure, I'm not too sure about the students because I wasn't really involved with customer service, I just remember a lot of mundane work like loads of letters that we had to put in letters in the morning, so we're not emailing the students 'cause most of the students didn't have an email account.

3: Dot matrix printers. The sound of that is still in my head.

4: Ah yeah exactly.

1: Daisywheel printers.

4: We didn't have photocopiers at the time, like when I was a student for instance, I remember having to do photocopy with that machine.

1: The Gestetner

4: Yeah, I remember getting high…

D: Did that take longer then?

4: It was just like rolling things, that was my time when I was raving. Every Saturday.

1: Every Friday afternoon I had to do quite a lot of those, and then you had sheets and you had to put them on the drum.

2: I need to send some tweets here! Secret life of librarians.

18.13

D: I think [redacted] (1), you briefly mentioned RFID in terms of the public library, but that's one thing that hasn't come up as well, kind of self-service and RFID.

3: Exactly

D: It all ties into having an automated system and things like that, but I just wanted to ask about that as a new technology, how do we think self-service has impacted on staff work and also on the users' experience as well.

4: I think it's been positive for staff definitely, because at least we don't have to manage queues and students are more independent so if they don't want to talk to one of us they can just go and do it themselves. To some extent I just think our system at the moment and UCL system, which is not checking the box, is actually detrimental to the collection, potentially I have found quite a lot of books that are damaged and don't have a stamp to say that they were damaged so it's really difficult to pinpoint who did it, but literally I've seen the collection deteriorating within the last few months. But I think it's positive definitely for the students, and the fact with the RFID it's so much better like

when we have odd shaped books the scanner didn't reach the...so at least, but I can't wait to have the flat things so we can just like put 5 books together.

3: We're not really going to know are we until we've got the full kit in, so it's very early days.

2: Also the wanding, you know, the shelf checking, for lost items and stuff like that, we haven't really investigated that.

D: So that's another potential use?

3: I've seen a demo of that, and that's quite unreliable.

1: Oh really?

3: Yeah it doesn't pick up a lot of stuff, 'cause any 2 tags close together they won't pick it up. We looked at that in one of the UCL meetings, you can download it, so…

1: If we get the flatbed scanners in, there should be a way of making, of doing stock taking more quickly...no? The flat bed thing is gonna be very good, 'cause most of the public libraries I use now do have that, and so you can and you can take your little pile of books. So long as it's working, it's like all these things, and of course occasionally there will be a book, especially if you've put in a request for an older book which might not yet have a tag.

3: That's right.

1: And our collection is like 98%, there are still ones coming through without the tags on.

4: I saw one the other day, I couldn't figure out why I couldn't issue, and I was like closing, in the end I opened up the back page and there was no tag.

3: There's an important thing about the user interface of those machines, and how far we can tailor them, you know the thing with the yellow arrow and the red arrow, it could be better, so the success of these systems depends on how much you can tailor that and how much, how much research have people done about how people interact with those machines, a sort of anthropology thing. They don't see the arrow do they.

5: They see the arrow but they don't connect it with putting it in the box.

3: We put a yellow bit on the box.

5: It needs to be clearer on the box.

3: Maybe we should just paint the box yellow.

4: Yeah.

3: That's it, spray the box yellow.

1: Yes

5: I think it's a human thing that some people see the arrow, and don't look around and think oh it must mean the box but some people don't see that they just see something over there, and they don't know what it means, they don't necessarily connect the screen, and what happens with the screen and what happens with the real world around them.

3: What if you had a little thing on there....

5: Do you understand what I'm saying?

3: Yeah what I'm saying is what if you had an arrow on there with a box on the screen.

5: Yeah that would be better.

(Group agrees)

3: Then you'd connect it with the real world.

5: That's an interesting thing to me, is that I realise they weren't connecting what's on the screen with a physical thing next to it they were just on the screen or they weren't.

3: Very interesting that.

1: Or they…

2: I was going to say I have a problem with the size of the tags, and this came up when that I was working in a music library 'cause you've got sheet music, it's usually printed on both sides, where do you put the tag? It's too big. You know, and then in the end you end up sort of creating a cover.

3: Oh yeah that's right.

2: And it's too much work, it was just impossible. Impossible to even sort of consider that, so I think that these manufacturers come up with stuff, which I know in theory was meant for industry and you know stock-take and all that sort of thing in the commercial world, but if they are going to use it for libraries they haven't really considered you know the implications of this. Even when we were putting tags on our books, some of our books are quite old on Level 5, and I kept having to say we shouldn't cover this 'cause that's quite important information you know? Inside the book, and we were covering it.

1: Sometimes the tags were ending up on the outside of the book

2: Yes

1: You would think that they should be able to make a smaller tag because…

3: I'm not sure that they don't, I'm not sure, they may not have bought it for this project, but I think there must be research going into this.

2: I think that there was a problem with the size of the tags that were available, we were looking, they were only you know, initially they were much bigger than what we're using.

D: So it has improved?

5: I guess with anything like this though, it's gonna be a fit for 90% or whatever %

3: That's it, exactly

5: There's always gonna be a percentage of things with any tech you look at that isn't going to be entirely suitable.

3: And when your senior people are looking at that they say ok it does 90% so the cost benefit analyses we're doing, it doesn't do the 10%

2:Yeah

24.42

D: Thank you, I'm just conscious of the time, that's all the great so we should probably move on. I hope you can all see the screen. So, we'll actually get onto some stuff about robots now. You'll remember from the survey, that's kind of what the research was about, looking at robots and Artificial Intelligence, and all of the stuff we've just been talking about as well, previous developments in automation, self-service, things like that. This is just the definition I used in the survey, which you would have all seen as well so I'll just read that. It's a definition of what a robot is:

'*A machine which can assist humans in everyday tasks without constant guidance or instruction, e.g. as a kind of co-worker helping on the factory floor or as a robot cleaner, or in activities which may be dangerous for humans like search and rescue in disasters. Robots can come in many shapes or sizes, and some may be of human appearance. Traditional kitchen appliances such as a blender or a coffee maker are not considered as robots.'*

So I just wanted to know what you thought of that definition, you would have seen it in the survey, obviously that's just one definition there are some others as well that may slightly differ, but did that kind of match up with your ideas of what a robot is?

(Group agrees mostly)

1: This is robots as opposed to cyborg?

D: That's another term which is used, what would you understand by cyborg?

1: Something which is more human looking like terminator, or the things in I, Robot. With much more of a...to me a cyborg is something which is more human looking.

5: I suppose it makes me think, the bit you've put at the end, I'm not quite sure where the boundary is between what's just an appliance and what's a robot.

D: Sure, and when we're talking about self-service that's something that could possibly come up.

3: See I look at it as something that's programmable, but that's me. The set of instructions that you've got there, that's a programme, it's a complex set of instructions that then lead it to do what you need it to do.

1: You don't really programme your toaster.

2: You can.

3: I expect the modern ones, you probably do, cars are programmable these days, a lot of them.

2: But are we talking about intelligence then? You see because you're talking about programmable and I'm thinking to myself oh well then in a way you can programme your coffee maker to come on a certain time, right? But where's the intelligence here?

3: Strictly I would say, you'd have the analogue, which is basically like a clockwork thing, but that's not the same to me as a programme, a programme is you know, a PC, instructions, but there is that thing about when is a computer really intelligent in the way a human is?

5: When it decides to give me an extra half hour in bed before work.

3: And it decides to do my job for me but I still get paid.

D: Well yeah, because Artificial Intelligence is another term that gets thrown around with robots, so maybe you have a different understanding of what the two things are.

2: Well for me, it would be like if it checks that I was really tired, by my body temperature, or my heart beat, or whatever, and then decided to give me an extra half an hour in bed 'cause it decided I was too tired to wake up, then there's an intelligence built into this, you see? So it's a programme, as such.

3: Whereas a robot's almost more mechanical isn't it?

2: Yeah I think 'robot's' a bit mechanical.

D: Interesting. And also, just wanted to ask about how people feel about the prospects of robots, or Artificial Intelligence, becoming more prevalent in society. Is that something you're aware of, is it something you've thought about?

2: Yeah, absolutely.

3: Yeah, totally.

1: They have, you see lots of things on...YouTube. You see pictures of them trying to get them to walk, and that sort of thing, because quite a lot of the ones which you have in your factories, they are, they don't really move around, they're sort of mainly static and then they paint the cars and things. It might move a little bit but not, they don't really choose where they're going. The thing which vacuums your floor, it sort of has sensors so that it's not gonna just end up knocking on your bottom of your wall, so they do seem to be trying to mimic humans. Human actions. Whether this is, they think they'll be more useful that way, or whether we'll be more accepting of them…

2: I think there's an element of acceptance, 'cause they're never gonna be as good as us. But when you think about it, if I was gonna vacuum my floor I know that I would do a really good job, I'm gonna get underneath the sofas, move the sofa, I'd get into the corners and stuff like that.

5: You can move sofas?

(Laughter)

2: You know that when you put one of these cleaners in, it's not gonna do that, and you know that you're gonna get a 60%/70% job if you're a perfectionist like me. You know?

1: It's like having a cleaner, you practically clean your house before the cleaner comes.

3: You wouldn't be embarrassed if it was a robot.

5: Doesn't everything depend on how it's been programmed as to whether it'll be accepted or not? I mean, at the end of the day if they can do all these wonderful things, it's a question of how far we want them to go.

3: Yeah.

5: And at some point, they're in control of something that you don't like the decision but someone's made the decision 10 years previously when it was programmed or whenever it was previously, someone's detached, the human's detached from that decision but the programme, it's in the programme. And what do you do if you don't like that decision, and how can you do anything about that if it's in the programme, the application.

1: Well they should, when they programme them, build into it the ability to reprogramme it.

3: Well that's very interesting 'cause if you look at our MFDs, and the problems with them, that's exactly what you've just said really. We wanna be able to change them, I was asking yesterday can we change the error messages, so the students know what the error is? It can't be done. It's hard coded into it, so that's a good point, it depends how well they do it, and what they're doing, and to me it's like let's get them to do as much drudge as possible so we can do some more interesting things.

1: Yes, it can go off and check the bomb before they send the team...

3: Yeah but I don't want them driving a car, that worries me to heck, the idea that self-driving cars.

2: We almost...when you look at Siri, you know on the Mac or whatever the Android equivalent is, you believe them, you trust them, because, most people, because everybody goes to Google for their first port of call. Everybody goes, and there's a kind of element of trust here, Google's gonna get that information for us, they're gonna get us from A to B sort of thing, and certainly because Siri is used to checking Google for a lot of the information, there's an element of trust here. You know? But if you talk to Siri, and talk to it like a human, you get complete nonsense.

3: You do?

2: Yeah

3: And that's a really difficult problem, 'cause that thing, computers are very good at doing certain things with masses of data that we can't remember, but really bad at doing normal things like

walking along, what we would think is simple. So I can't see that really getting much more sophisticated for quite a long time, I might be wrong.

2: Having a robot to walk your dog.

5: You mentioned driving cars, 'cause there's an ethical problem. If you set it to be programmed to drive a car, be programmed to avoid pedestrians, if a pedestrian walks out in a tunnel. There's a specific problem where there's a tunnel with a pedestrian who will be killed if the car goes straight on.

3: Or it saves the driver.

5: Or there's another car coming the other way, and six people might be killed if the car swerves to avoid the pedestrian, the computer programme would say kill the pedestrian.

2: Yes

3: It would

5: Ethically, where does that leave you?

3: Really big questions there.

34.38

D: So, on that note, again you might remember these from the survey. So these were just some examples I gave of potential uses for robots in libraries, and if you remember I asked you to rate how comfortable you would feel with each of these hypothetical things. So, if we wanna split into 2 groups, [redacted] (4) you can go one way or the other. Help yourselves to pen and paper if you want, you don't necessarily need to write anything down, I should've said that at the start sorry. So I've got them here, and I'd just like you to spend a couple of minutes and just kind of rank, so at the top you would have the thing you would be most comfortable with, and again we can consider the IoE Library with this, so how comfortable would you be with this particular robot being used in the IoE Library, so the top would be the most comfortable then going down to the one that you would be least comfortable with. So just kind of have a little discussion around that, just based on those definitions.

(Group discussions)

38.36

D: Do we have some kind of order now? Good stuff. So if [redacted] (1) and [redacted] (2) you'd like to start from the top and say which one you were happiest with, or most comfortable with.

3: We were different, we varied.

D: That's fine.

1: The online Library Chatbox available 24/7, it would answer basic enquiries about the Library, because it would be nice and static and they could just go to a point and press a button and the thing would tell them, sorry the robot would tell them, the information point would tell them.

3: In a Stephen Hawking voice. 'The toilets are downstairs. Turn right.'

(Laughter)

4: 'Be careful with the falling tiles.'

(Laughter)

3: 'Danger'

1: We'd get Brian Blessed to do it.

(Laughter)

3: I'm all over that.

D: And did you agree with that [redacted] (2), at the top?

2: Yes we agreed on that.

D: And what's next?

3: The security guard.

1: The security guard. Well I wasn't very happy with this but [redacted] (2) really liked it because then we wouldn't get the stick. The robot would tell them off, we wouldn't have to go around telling people off.

2: we wouldn't have to keep telling people not to sue their phones along here (outside corridor) it's really difficult.

3: Tasering

1: Can you imagine a robot telling, and taking their food away from them, and telling them…

2: 'You are not allowed…'

3: 'Please put your food away'

D: And why were you less comfortable with that one then?

1: Well I really don't think I'd like a machine coming up and telling me to stop talking on my phone.

2: And you would ignore it.

1: Well it might end up as a squashed machine

Laughter

1: Put it that way, that could be the trouble, that your users might become violent towards the machine, which they wouldn't do towards a human, we hope.

Laughter

2: You never know.

3: It could be part of the UCL dignity at work policy - robots will be treated equally to humans.

1: Oh dear, no! This is an intelligent, sentient being. You haven't watched enough Star Trek.

4: Potentially the robot guard would make more noise.

1: Yes.

2: We could have silent ones.

4: And whispering ones.

D: What did you have next?

1: [redacted] (2) was very keen on the robot shelver that would be able to identify and locate different library...and I didn't think this was feasible, and we'd have to have extremely large shelves. Whereas I thought that a robot assistant that would help you find your way around the library, that might be quite fun. So that's why those 2 ended up equally, 'cause we're compromising.

D: Sure.

1: But an online Library Chatbot, available 24/7 that would provide an advanced enquiry service e.g. guidance on search methods, we didn't really think that this would work, we think that this is where interaction with humans is still the best.

2: That's because we have to really get to the bottom of the enquiry.

D: So that's why you've got the distinction between the 2 chatbots?

1: You have to be able to change direction, according to what, as you go on with your search.

2: And interrogate the user.

1: You have to be able to change, and I don't, we don't, think that computers, sorry robots, would be able to do this. And I don't think our users would like this It's a bit like going to the doctor and getting the doctor, the robot, to diagnose your disease. Don't go there.

D: Thank you, and this group? Any differences?

5: The same on the 2 chatbot ones, so the light chatbot at the top, the deep at the bottom.

D: Any different reasons, or similar? The level of complexity?

4: Exactly.

5: Between the middle we were rowing about.

3: I think we could put those 2 together.

5: We didn't on the whole think the security guard would work, for some of the reasons [redacted] (1) and [redacted] (2) were mentioning, especially it would be a red rag to a bull to try and outwit the robot security guard. So I didn't think that would work at all. The other 2, the assistant that would help you find your way around the library, I didn't like but some people did.

D: What were the positives and negatives for that one?

3: For me, it was because that's a feasible thing that can be done, whereas the other one, which was the robot shelver I just don't think it's feasible because of the complexity of, you know, stock and…

5: I disagree, I think the shelver, if it's technologically feasible, like are any of these technologically feasible I'm saying? If there is the feasibility I think that works well, then why not have a robot shelver?

D: So it's a feasibility issue?

3: Are any of these feasible?

2: Couldn't a robot move the shelves, the books, if there isn't space, do you know what I mean?
5: Those are practical issues, but if you can, there are places that have robots going to massive shelves on RFID, and it is technologically possible.

2: Ah yes.

3: Yeah, we're saying it's not practical in a small library like IoE, Library of Congress they're probably…

5: well this is whether we're comfortable with it or not, I'm perfectly comfortable with it if it works.

D: If it was feasible?

2: I wasn't thinking about it in terms of the IoE library only, I was thinking of it...

1: We wouldn't have all of our wonderful shelvers, and we wouldn't be providing work for people, are we going to take jobs away from people?

4: That's true.

3: Very good point.

1: And cost.

2: I was thinking about it more in terms of capability, than in terms of ethical issues.

1: If you had a space on the shelf, like if you're doing it in a parts factory or warehouse or whatever...

2: You'd know exactly where it slotted in.

1: And then you've got Box A, Box B, Box C, Box D, and it goes ok this goes to Box B, 'shooo donk'.

3: That would work very well, but our shelving isn't like that, it's fluid, the boundaries of each shelf change as we get new books, slot them in, classification schemes don't work in that way. So the cost of retrofitting the library each time that happened would outweigh the benefit of having the robotic shelver.

5: But if it worked…

3: But it won't.

1: If it's feasible then yes, I would be comfortable with it, whether, I'm not sure about how it would treat our stock. 'Cause some of our stock is delicate.

3: It would have a pincer and a clamp that went like that (claps hands) puts the holes in it, brings it out and drops it. And then runs over it.

(Laughter)

46.28

D: So I did say these were hypothetical, I think it did come up, maybe [redacted] (5) you were aware of one real-life example of this. They were all loosely based on real-life experiments or real-life things that have been implemented in real libraries, to various levels of success. So I was just gonna show you what those are.

1: I've actually seen this at Boston Spa.

D: So obviously you were thinking of this in terms of the IoE with our open shelving, so it is slightly different, but this is what [redacted] (5) was referring to as well. So this is a good example in the UK, obviously it has to be purpose built and it's all built around the basis that it can be automated.

3: and it's a closed door isn't it, a closed stack.

D: Exactly, so it's not browseable, but then you can store a lot more items in there.

1: You can go and visit the Reading Room and put in requests and they will produce the stuff for you.

D: I think there are a lot of examples of this in the US as well, a lot of universities there have got facilities that are fully automated, I think some of them the users can actually look in and see the machines working but obviously they're not browseable shelves.

5: I think Bryan's been to see one.

D: This is using a similar technology, but can be used on the open shelves, and this is all because of RFID.

3: Yeah.

D: It's able to remotely read the books' locations, it uses 3D mapping technology as well, so it would have a map of library in place, so it avoids obstacles and things like that. I think the idea with this is that they would program it to maybe go and find a missing book that's been misshelved, it could do kind of stocktaking.

1: So it is not shelving.

D: No, exactly, not physically shelving, but able to locate items.

3: Scanning.

1: And do you actually have to keep your shelves like that so the machine can do the work, so you've gotta do all that work so it can do its job.

D: That's it, and that's something about RFID as well, you've obviously had to put these things in place to allow these things to work. Sorry, I should have said, so the name of this one, not very catchy, Autonomous Robotic Shelf Scanning System.

3: ARSE

Laughter

D: This is Hugh, they've named this one. It's just a prototype so that's not what it would like if it was actually working, it's quite a recent one I think they were developing it earlier this year at Aberystwyth University, and the parallel for this one would be the one that can take you to the shelf and find an item for you, using voice recognition. So the idea is that the user would be able to talk directly to this robot, it would then have access to the catalogue.

1: Oh it's K9

D: And then that would be able to lead the user, like I said it's a prototype so we don't know how well that one works but that's that one.

2: Can't we just train dogs here?

D: And this one…

4: It's a female isn't it? That's got boobs…

3: Oh the robotic security guard.

2: He's so cute.

D: Not the scariest, but yeah this was developed with G4S the security company

Laughter

3: Bet that didn't go well then.

D: So it was originally developed by the security company, not specifically for libraries, but they decided to do some testing at the University of Birmingham in the Library there. So this obviously matches up with the security guard example. It was just able to kind of patrol like I said, it could notice changes in the environment…

2: Food

D: Potentially, I think the example they give is if a desk, desk spaces, or if things have moved, and the idea is it can go and report things like that back to the real human security guards.

1: Eek, mouse! Let loose the cat.

3: Mouse, theft...

D: Potentially, and the other important...Bob is also able to, when it runs low on power, it can detect that and go back to the power point.

2: Plug itself…

3: Plug itself in.

Laughter

D: Ok, and then if we're talking about the chatbots, this is Xiaotu, and this was in a Chinese university, I think in Beijing, Tsinghua University, described as a smart talking robot. The thing with Xiaotu, they introduced it, so it's the kind of 24/7 availability, sorry I'm just finding…

1: Do you notice you've still got to wind it up?

D: Well that's an interesting thing 'cause they could have just had a window, but they decided to have this avatar, even though this isn't a physical robot, it's just online, but I think they had a campaign with the students where they could pick their favourite picture for it and they've given it a name as well. It translates as 'little library, Xiaotu. It's programmed with natural language communication, so you can actually have a conversation through that...

2: Siri…

D: Similar to that yeah, and it's connected to different databases, so connected to the OPAC of the Library, also Baidu Baike the Chinese version of Wikipedia, and another important thing it's supposed to be able to learn from its interactions, so as the users talk to it if there's something it doesn't know the user could kind of program the response. That would obviously then need to be checked by the library staff, otherwise you might get some…

1: They might be teaching it to swear like you teach a parrot.

D: Exactly, yeah. So they're some of the examples, so I wanted to ask, based on seeing the real-life versions of these things, does that change the way you feel at all, does it make you rethink any of the opinions?

2: I think I'd put the security guard to the bottom now.

Laughter

2: As cute as he is, I'm not so sure he has authority or presence.

3: It's a talking point though isn't it.

2: It is a talking point.

3: Students might engage with it.

2: But they'll get tired with it in no time.

4: It'd be a novelty at first, and then after I think definitely they'd be like let's mess with the robot.

1: The shelving system, in that circumstance, works in that particular environment, that particular place, I think they couldn't cope as well as they do without it. It must make their lives so much simpler, but what happens if it goes wrong, drops it in the wrong box? Sorry I'm very gloomy.

5: 'Cause people never do that do they?

Laughter

1: No no no people never do that, but can you imagine trying to find something.

3: Well, I guess you could have it do a scan of everything night and when the place is shut, it would be able to find books a lot easier than we would, that's what a computer could do. Actually find the lost books, that's a great application for this.

1: The one that is scanning, I thought that would be very useful if...but you seem to have to do a lot of work before the shelves are ready for it to do that, and to keep them like that.

2: I think the robot would keep them like…

1: No all that one's doing is scanning.

3: Well you'd have to program it, 'cause I mean we've got different types of shelves, different heights, different numbers of bays, so it'd have some kind of, I dunno, shelf mapping. See where I'm going with this, a shelf map like we used to have on our OPAC, where you told it how big everything was and gave it a plan, and it would know where it was, I don't think that's too hard?

1: If you had a case, a box, for every book, and they were all uniform. So your book then just went, but that'd be a waste of space. Space is always a problem.

D: So how do they make you feel about the future of library work, and maybe how your roles could be potentially affected, not just by these but by other developments in robotics and AI? Are there any other thoughts on that, on how roles could change or be improved, or not improved potentially?

5: It's always difficult to look into that, because while you can see that in theory, and being positive, you lose the drudgery and then you get to do the more interesting stuff, but then you're also worrying well if there's a bit less drudgery they don't need so many people so there aren't as many jobs. In theory it's all very positive when you get to do the more interesting stuff, I can see that, 'cause you want to be answering these queries not those queries, so the queries should be complex.

4: You'd also be dealing with a lot of problems, so troubleshooting all the time, you wouldn't actually...so people would come to you after they've exhausted all the things there and they might be really frustrated, because the length of time that they have actually spent and that wasn't successful and then they finally get to the person that's supposed to be the expert, the librarian.

5: Sometimes you need the drudgery, sometimes you need a little bit of that in your job anyway, but if it all goes and you're just, as [redacted] (4) says, if you're left just dealing with things that computers can't deal with when somebody's really wound up, or they've got a real problem.

2: But I think actually it would release us to do a lot more interesting work, in terms of being embedded in the whole teaching and research process, which we don't have time to at the moment 'cause we're on desks. For me, it would be absolutely brilliant. Also in terms of curating content, we would focus on that more, and I think provide a better service as a result of that. I think that we would be able to promote our collections better, as we'd have all this expertise which I think is kind of watered down because…

3: Yes, I agree.

2: We either don't have time to talk to each other, we actually don't have time to think sometimes…

3: There's two sides to that, I mean you're right about that and that's really important, and I don't think, this has been going on anyway for years anyway with computers. It hasn't happened, what they said in the 60s, with everybody's not working anymore in that same way, so I'm fairly optimistic about that. But the problem is, you could get into the situation where the users, what the user needs is forgotten, 'cause they're dealing with computers. Look at the MFDs, who's actually consulted with the user to make sure the user experience stays good, because the people who are responsible for that are Xerox and some people up there who don't care about it. So that's the danger of going down this direction, but it's clearly where we're going.

1: And the other thing is, what happens when they go wrong?

3: Indeed.

1: Who's going to repair them, 'cause they're as, I've totally forgotten the name, there's a film from the 80s which, a chap is a policeman but his section of the police is dealing with robots which have gone wrong, so they have to go to the fields when the harvesting robot has gone doolally, and catch it and turn it off and take it away to be repaired or that sort of thing, so obviously they're very useful 'cause they're doing the construction work and welding up at great heights and all these sorts of things, which are quite dangerous, but what happens when it decides that it's, today I'm going to pile bags of concrete, doesn't matter that I'm doing it 3 foot over the edge of my 50 foot height building and just dropping them on the floor on top of people.

3: So that's when you need to have people there, to fix those things, but those people need to be actually in the organisation, not in another organisation and outsourced. So, again, you're back to…that's where your new jobs are, there's people that need to look after this stuff and program it. I might even get my job back.

1: So you're going to have to retrain people, which sounds marvellous, but can be quite difficult in some situations 'cause not everybody is…good at learning pernickety things.

3: That's why it needs to be much simpler, and that's what I'm saying is that these things should be designed so we don't have to all learn all the things about it but there's someone whose job that is to do, rather than it being our job.

1: So we can do the simple things, like with the MFDs, we can put new paper in…

3: exactly.

1: We can put new toner in, we can generally do the paper jams 'cause it tells you where the paper jam is, if you follow the little things. So those simple things we can do, but yes it would be nice if there were people…

3: So we don't want to be fixing all the problems, where it hangs and there's a message and we don't know what to do.

1: No.

3: That should be someone else.

1: But like you said somebody in house.

3: In house.

2: They're not robust enough in other words, so you need that technology that's going to sort of take care of itself. And it's going to, perhaps, fix itself in some way, you know that's where again the intelligence comes in because if we're not feeling well we'll take a paracetamol or something, what does the robot do in terms of fixing itself?

1: We need some sort of diagnostic…

3: Self-diagnostics.

D: I'm aware of the time, I think we've come up to the hour mark, I've just got one final question, again thinking of these examples and the other ones we've talked about. Just wondering if anyone had any opinions on the way they're described, and the way some of them have names, some of them are called, maybe a robot librarian, not necessarily by the people that make them but when they're reported in the media and things like that, how does that make people feel?

2: Threatened…

3: I just think it's silly, I kind of laugh at it.

2: I do feel, if you say robot librarian, you do feel like threatened because you think like Siri's taking over your job, and you know that Siri's not gonna do a good job, yet you think that the public are gonna think, because they already do, that Google provides all the answers, you know? So you do feel threatened, and you do feel kind of sad for the future of humanity, because if you're gonna give crap, garbage in garbage out sorta thing, that's the kind of stuff that…

3: This is the Trump approach isn't it?

2: Yeah, absolutely, so for me it's a real issue, no matter, and even if you give them the cutest names like Bob or whatever this one is called or the other one, doesn't really matter because I think a lot of people…also they're a bit boring, you know? They're kind of, they're very one-dimensional.

3: They've not got much personality have they?

2: And at the end of the day I think we want interest, because we're sick and tired of all this kind of post-truths that are thrown at us, if that's the right expression.

1: Sorry, pardon?

2: Post-truths.

3: But what's really important is what young people think of them, not what we think of them. You know, people your age or younger, that are coming to universities, how would they see them I wonder? Whether it would just be like a gimmick to them, they wouldn't think these things could take care of it or whether they would, I don't know I just think it's interesting that. We need to know more about what they think.

1: And also, perhaps there could be cultural differences because there could be certain cultures where there is a higher incidence already. I mean Hive where you can switch on your heating from work, they have wonderful adverts, very cute adverts, but I'm not sure if I'd be too happy.

2: No, and I'd worry about children relying on these, you know it's alright to have a soft toy or Furby or whatever it was called, the kind of craze…

1: Tamagotchi

2: Yeah, Tamagotchis or whatever, and that's ok because it was just kind of you know, again a temporary thing. I can't see this, I had an older woman come to me today for a one to one, and she was apologetic, she was looking in my eyes, you know, and she wouldn't have gone away satisfied if she'd had a robotic response to her - 'yes well you're stupid that's why you don't know how to do this' kind of stuff or whatever, or that kind of feeling as if she wasn't actually getting to me and telling me that she was very sorry that she didn't understand what she was expected to do.

D: So that kind of human interaction?

3: Yeah

2: That human emotion, that open heart approach to communication.

3: Empathy. Robots do not have empathy.

2: Empathy's the key thing.

5: I think with the naming thing, and the marketing, whenever I'm aware that someone's marketing something at me I just ignore it.

2: just tune off.

5: I try and ignore it, I don't suppose you can ignore it completely, so the name doesn't really matter. Once it's named, that's it you forget.

3: I just take it less seriously.

1: It's like when I have a car, a Ford Fiesta Carnival, which meant it had 2 pretty stripes and some balloons on it. So my Ford Fiesta was a carnival.

3: Nice.

4: Anyway, if we have a robot in the IoE I vote for Andy as a name.

(Laughter)

1: It stands for Handy Andy.

D: Ok I think we should wrap up there. Does anyone have any final comments or any questions?

1: It'd be interesting to come back in 10 years' time. See what happened.

2: I would love to read your dissertation.

3: So would I.

1: Yes please.

D: If it ever gets written I'll make sure I share it with you.

5: Surely the robot's working on it now?
(Laughter)

D: Thank you all very much, I'm stopping the recording now.

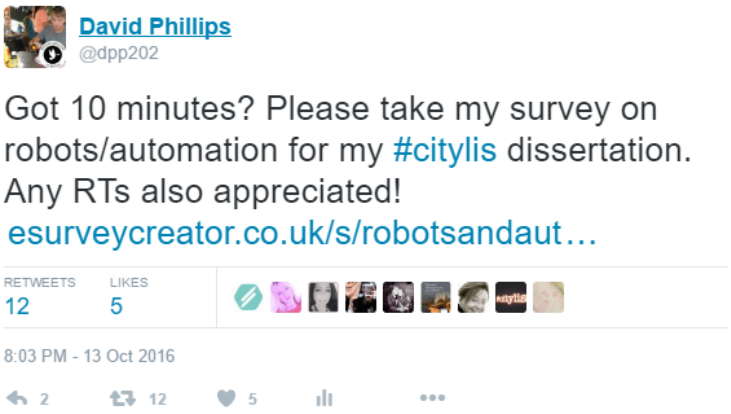
01:07.36

Appendix B: Correspondence for Survey/Focus Group recruitment

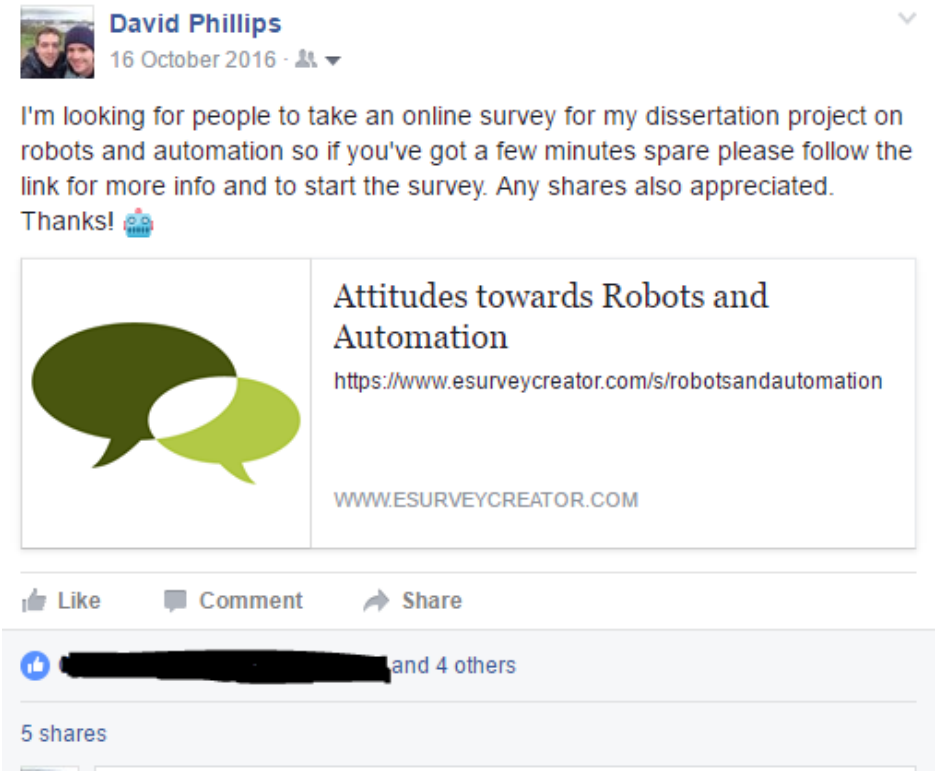
Any names have been censored for confidentiality reasons.

Survey

Twitter



Facebook



Email to colleagues

Dissertation survey

PD Phillips, David
Mon 17/10/2016, 13:03
+IOE.Library Staff

Reply all

You replied on 26/10/2016 14:25.

Hi all,

I'm currently working on my Master's dissertation and as part of this I'm carrying out an online survey - I hope you don't mind me making a cheeky request for participants.

I'm looking into the possible impacts of advances in automation, but I don't want to give away much more than that so if you get the chance please follow the link to find out more and to start the survey...

https://www.esurveycreator.co.uk/s/robotsandautomation

I'd be really grateful if you could take the time to help me out, it shouldn't take longer than 10 minutes.

Thank you in advance!

Cheers,

David

Focus Group

Call for Participants

Dissertation Focus Group on 21/11/16 or 23/11/16

Phillips, David
Thu 10/11/2016, 17:00
[redacted] +25 more

Reply all

Sent Items

You replied on 16/11/2016 10:39.

Hi all,

Following your very helpful participation in my dissertation survey I'm now hoping that some of you will be willing to take part in the second part of my research.

This will consist of a one hour focus group (held here at the IoE) to discuss the issues covered in my survey in a bit more depth – including areas such as Self-Service, RFID, automation and robots.

Anyone currently working in the Library/Archives is welcome to take part, and the only thing you will need to have done beforehand is completed the survey. Drinks and snacks will be provided as a thank you for those attending.

Please be aware that the discussion will be recorded and then transcribed for the purposes of my dissertation, but the recording/transcription will not be shared with any third parties and participants will be anonymised when I write up the findings.

I'm planning to hold the group on one of the following days in the Library Teaching Room:

Monday 21st November: 17.15 – 18.15
Wednesday 23rd November: 17.15 – 18.15

If you would like to attend please let me know which day(s) you are available and I'll pick the most popular – apologies if neither are suitable.

If you'd like any more information please just let me know.

Thank you!

David

David Phillips
Library Assistant (Circulation)

UCL Institute of Education
University College London
20 Bedford Way
London WC1H 0AL

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Twitter: @IOELibrary
Newsam Library News: http://newsamnews.ioe.ac.uk/
Find out about our collections and services at http://libguides.ioe.ac.uk

Confirmation Email to volunteers

RE: Dissertation Focus Group on 23/11/16

Phillips, David
Wed 16/11/2016, 10:39
[redacted]

Reply all

You replied on 24/11/2016 09:45.

Hi all,

Thank you very much for volunteering to take part in my focus group.

Wednesday 23rd November was the more popular of the two days so that is when the group will take place.

The group will be starting at **17.15** in the **Library Teaching Room**, so please arrive at least 5 minutes before then if possible. It shouldn't go on for more than an hour, so we'll be done by 18.15.

You won't need to bring anything with you, and as discussed I'll be providing some (soft) drinks and snacks to make up for keeping you at work late!

If you have any questions, or if you can no longer make it, please let me know.

Thank you,

David

Appendix C: Proposal and Reflection

Dissertation Proposal

Working title

Robots in the Library: gauging attitudes towards developments in robotics and AI, and the potential implications for library services.

Introduction

In the 2012 film *Robot and Frank*, a near-future is depicted where robots are utilised as personal companions, home assistants, and library helpers (with basic Library Assistant abilities such as greeting patrons and re-shelving books). While this kind of scenario has long been a mainstay of Science Fiction, we are increasingly seeing that the types of tasks previously carried out by human workers have the potential to be equally well (or better) performed by machines, and the once fantastical way that robots have been depicted in popular culture is becoming more and more of a reality. This has been present in areas such as manufacturing for a while now, but is also appearing in increasingly complex fields such as autonomous vehicles, legal research, and areas of medicine such as surgery.

Whether or not such machines have the capability to be 'intelligent' in any real sense is a source for much debate, but many would argue that it is the ends, not the means, that is important – if a smart machine can complete a task more quickly and efficiently than a human then it does not necessarily matter how it does it (Floridi, 2014). In recent years there has been a lot of attention, both in the media and in serious research and studies, given to the idea that robots will 'steal our jobs', with obviously serious implications for those whose jobs are replaced, as well as those who will in future be 'served' by these robots.

In terms of libraries, we have already seen a move towards a level of automation in a range of traditional library tasks and roles, such as increasingly advanced OPAC and Discovery Layers replacing traditional card catalogues, self-service machines (further enabled by the use of RFID) replacing the traditional issue counter, and online FAQS and chat-services replacing traditional reference librarians and enquiry services. While these advances do not demonstrate an introduction of AI or robots, they do show an increasing willingness for services to be provided without direct human contact, which could be an important factor in the possible acceptance of future developments.

Although we may still be a long way off seeing the widespread implementation in libraries (and in many other sectors/industries) of the kinds of robotic helpers and AI seen in popular culture, there have already been significant experiments and early trials in libraries across the world, as we shall see. This proposed study will aim to explore peoples' current perceptions of such technologies, and to what extent both library users and staff are willing to accept them.

Aims and objectives

Aims

- To evaluate the current state of AI/robotics, particularly with regard to how this will impact on human employment.

- To analyse existing research into peoples' perceptions of AI/robotics and how this could be relevant for LIS.
- To explore existing examples of automation in LIS and whether this has been successful.
- To explore perceptions of AI/robots in a Library context and examine peoples' hopes and fears about the future

Objectives

- Gauge and analyse participants' general awareness of AI/robotics, and to what extent they think it will affect them directly
- Determine whether library users prefer a human (issue counter staff/reference librarian etc.) or are happy to interact with a machine/computer (self-service/LibAnswers etc.)
- Establish which areas of library services users/staff would be willing to 'hand over' to AI/robots

Scope and definition

While the research will consider the impact of developments in robotics and AI on a broad level, there will be a particular focus on its current and future use in libraries, using existing real-world examples as well as examples from popular culture/fiction. As this is a subject that could potentially affect everybody, there is no real limitation on who the research could potentially be relevant to. However for the library-focused aspect, the sample would be restricted to regular library users and current library staff.

It is important to mention here that the study will not be too heavily focused on the deep complexities, both technological and philosophical, surrounding the idea of AI and the potential for truly sentient machines. While there will certainly be a consideration of these areas, with the ideas of key figures such as Floridi playing an important role, the main purpose of the study is to gauge a range of peoples' views and preconceptions, whether or not they have any advanced knowledge of the topic. The social and cultural implications of robots and AI are what will be examined, so it will be just as important to discuss what people think is currently possible, and may be possible in future, even if this is not supported by the available research and expert opinion. This is of course a sensitive area, as there is a very real sense that peoples' jobs and careers may be at risk, so it will be important to clearly define any terms used and to avoid any kind of 'fear-mongering' or unnecessary conjecture.

There is much debate over what is actually meant by Artificial Intelligence (AI), and there are many alternative or related terms associated with it, such as robot, autonomous machine, deep learning, neural networking and so on. Kaplan (2015) draws a useful distinction, with his idea of *synthetic intellects* and *forged laborers*, and Floridi (2014) also gives definitions of different Information Communication Technologies (ICTs) which can be included under the umbrella of AI, such as a*rtificial companions* and *smart agents*. Recent surveys by the European Commission (2012 & 2015) have made sure to clearly define what they mean by a robot:

> …an autonomous machine which can assist humans in everyday tasks e.g. as a kind of co-worker helping on the factory floor or as a robot cleaner, or in activities which may be dangerous for humans, like search and rescue in disasters. Robots can come in many shapes or sizes, including human-like. Traditional kitchen appliances, such as a blender or a coffee maker, are not robots.

This will be the kind of simple definition used in the study in question, with some possible modifications to apply it to a library environment: such as the idea that a self-service machine is not a robot, but a re-shelving machine would be for example.

The initial survey will cast a fairly wide net in terms of respondents – while there will be questions referring directly to the use of AI/robots in libraries the respondents will not necessarily need to be regular users of, or working in, libraries to participate. Also there will be a consideration of various types of library at this stage (academic, public, legal etc.). There will be an attempt to gain as representative a sample as possible. The focus groups which follow the survey will involve only regular library users or current library staff, to gain a more in-depth perspective. At this point there may be a focus on a particular type of library (e.g. academic) depending on where the participants' experience lies, but broader topics/fields will also be discussed.

Research context/literature review

The motivation for this research has emerged from an observation that there appear to be more and more articles and think-pieces being written about the apparent dangers of robots (or intelligent machines) being able to carry out previously human jobs. As Bollegala (2016) argues: 'Since the industrial revolution, roles that were once exclusively performed by humans have been slowly but steadily replaced by some form of automated machinery,' so this is by no means a new phenomenon. However there does seem to be a definite consensus that recent advances in AI (and other surrounding technologies) will lead to replacement of humans in a much bigger, and more complex, range of workplaces than has ever been possible. This certainly includes libraries, and as we shall see there have already been significant experiments and early implementations of robots and AI in a library context. However it does not appear that much research has been done into how library users and staff feel about such developments, so that is what this study will attempt to do.

Much of the discourse around developments in AI and robotics is polarised, between a utopian view of a world where humans no longer need to work and are served by robot assistants, and a dystopian alternative where the machines have surpassed human intelligence and potentially wiped us out completely. The likely reality will probably be somewhere in between, as argued by Kaplan (2015): 'Recent advances in robotics, perception, and machine learning, propelled by accelerating improvements in computer technology, are enabling a new generation of systems that rival or exceed human capabilities. These developments are likely to usher in a new age of unprecedented prosperity and leisure, but the transition may be protracted and brutal.' While the eventual outcome could indeed bring great benefits to humanity, we need to be careful how we get there and consider the impact on society as a whole, not just those individuals who will be first to profit.

Floridi (2016) has a similarly nuanced perspective: 'How some nasty ultraintelligent AI will ever evolve autonomously from the computational skills required to park in a tight spot remains unclear. The truth is that climbing on top of a tree is not a small step towards the Moon; it is the end of the journey. What we *are* going to see are increasingly smart machines able to perform more tasks that we currently perform ourselves.' He argues that 'true AI' is completely implausible, but that it is still important to consider the many implications of rapidly advancing ICTs, which are transforming our concepts of reality into what he calls an 'infosphere' (Floridi, 2014). A key point that Floridi (2014) makes is that 'ICTs are not becoming more intelligent while making us increasingly stupid. Instead, the world is becoming an infosphere increasingly well adapted to ICTs' limited capacities.' An example of this in the Library world would be the introduction of radio-frequency identification (RFID), which has allowed for much easier self-service, and could theoretically completely remove

the need for library staff to handle books, as a sufficiently advanced machine could read the data on the chips to monitor circulation, as well as locating and re-shelving.

There has been much research already carried out into the likelihood of particular jobs being at threat, synthesized here by Handman (2016): 'Boston Consulting Group predicts that by 2025, up to a quarter of jobs will be replaced by either smart software or robots. Gartner, a technology research firm, ramps that estimate up and predicts that one third of all jobs will be eliminated by 2025, while University of Oxford researchers Carl Benedikt Frey and Michael Osborne say a grand total of 47 percent of US jobs will be automated by 2033.' The BBC (2015) even produced an interactive 'game' based on the University of Oxford research, where you can type in your job title and find out the likelihood of it being automated, with 'Library clerk' receiving a 97% rating, and 'Librarian' 52%.

There have also been several large-scale surveys carried out to measure public attitudes towards AI and robots. The European Commission (2012 & 2015) has published reports of surveys which were designed '…to gauge public opinion towards robots by measuring public perceptions, acceptance levels, worries and reservations' across the EU. There is a commercial element to this research, as demonstrated by this statement: 'Robotics is a key technology for Europe's future competitiveness. Robots enable efficiency in all manufacturing and production sectors and contribute to employment in the European Union. Public perceptions of robots, are however, often influenced by misconceptions and fears' (European Commission, 2012, 4). These studies, which were able to use a representative sample of over 20,000 participants, demonstrated a generally positive public perception towards robots and their potential future uses, but with serious reservations around their threat to employment: 'Nine in ten respondents (89%) think that robots are a form of technology that require careful management, and seven out of ten (70%) people believe that robots steal people's jobs' (European Commission, 2015, 4).

A similar survey was carried out by the British Science Association (2015) '…to see how the public thought robotics and artificial intelligence will affect society and culture.' From a much smaller sample (2000 responses) the main conclusions drawn were that 60% thought that the use of robots or programmes equipped with AI will lead to fewer jobs within 10 years, and 36% believed that the development of AI poses a threat to humanity (British Science Association, 2015). There was further exploration of exactly what kinds of jobs people thought it was appropriate for robots to carry out, with over half those surveyed saying they would not trust robots to perform surgery, drive public buses, or fly commercial aircraft (British Science Association, 2015). Despite this seemingly pessimistic response the BSA chair, Lord David Willetts, manages to put a positive spin on the research: 'People will always want human experiences: robots will not kill the radio star, and we will always want to interact with other people. In fact, the greater problem is that artificial intelligence cannot quickly enough fill jobs that are going spare' (British Science Association, 2015).

We have seen that there has already been much research and writing around the potential uses of AI and robots across various sectors, and the implications for the people working in and using them, but not much has so far been done which directly relates to libraries. One key example is the work of a Chinese university library in Beijing, which introduced '…an artificial intelligence (AI) talking robot called Xiaotu (female), which plays the role of a librarian in different locations on different terminals simultaneously and attracts users to participate in the resources collection in an intelligent and highly interactive manner' (Yao, Zhang & Chen, 2015, 245). It is interesting to note that although Xiaotu is referred to as a robot, she has no physical form and appears only as an animated character on a screen. Xiaotu's capabilities include natural language communication, giving 'expert answers in professional fields', book searching in the OPAC system, searching in Baidu Baike (Chinese version of

Wikipedia), self-training and learning (through interaction with users), and the ability to integrate with other systems such as social media (Yao, Zhang & Chen, 2015, 249).

The creators are open in admitting that not everything with the launch of Xiaotu has run smoothly, such as repeating inappropriate language from its users through its learning function, a story that was even featured on the Daily Mail website (Baker, 2012), and was similarly experienced by Microsoft with their AI-based chat-bot Tay earlier this year (Floridi, 2016). The results from their user questionnaires and interviews also suggest that there is much room for improvement: 'the cranial capacity of Xiaotu still needs to be enlarged to improve her intelligence quotient. Librarians, particularly subject librarians, are expected to provide several valuable corpora. Content collection activities could be held among users to enrich Xiaotu with trendy topics popular among the youth' (Yao, Zhang & Chen, 2015, 256). What is perhaps most interesting is the apparent willingness of the library staff to help with the creation and improvement of Xiaotu, and encourage their users to do so to – she is not seen as a threat but as a welcome addition to the team.

There are also several recent examples of actual physical robots being introduced into libraries for various reasons, which have received attention in the press (albeit mostly on a local level). 'Bob' is an autonomous robot who was developed at the University of Birmingham, and initially put to work as a security guard for the firm G4S, but then given the role of 'library disciplinarian', to ensure that '…desks and tables are kept clean and tidy,' and discourage 'messy students' (Yorke & White, 2014). Bob is part of a bigger project called STRANDs '…where robots will learn how to act intelligently and independently in real-world environments,' and he even has a 'brother' called Werner designed to work in care homes, playing games with the residents (Stacey, 2014). The fictional world represented in films such as Robot and Frank (2012) arguably seems closer and closer with developments such as Bob and Werner. As with Xiaotu there is an assertion that these kind of robots should not be seen as a threat: 'The STRANDS project isn't going to produce a robot which can replace a human, but what it is going to do is support the security team by adding an additional patrolling resource' (Stacey, 2014).

A similar project carried out by robotics students at Aberystwyth University resulted in a so-called 'robot librarian' called Hugh, which has the ability to take verbal book requests, work out where the hard copy is, and lead students to the relevant bookshelf (Saufenberg, 2016). The creators describe Hugh as a type of 'narrowly artificially intelligent robot' which could be programmed to operate in various different environments, tying in with Kaplan's (2015) idea of *forged laborers* and Floridi's (2014) concept of smart machines. Again there is an apparently positive response from the library staff working with Hugh, with one manager stating that: "The response of staff…has been fantastic, and we look forward to working with them as they test the prototype over the coming months…It will be fascinating to see how students interact with it, particularly speaking to the robot in what is essentially a quiet area for study' (Saufenberg, 2016).

An interesting argument is raised by philipbradley_276534 in the comments section of Saufenberg's THE article about Hugh (2016):

> Well, let's see. Can it search a database? No. Can it recommend a database to an enquirer? No. Can it provide advice to an enquirer? No. Can it provide a list of useful, authoritative and validated resources? No. Can it help an enquirer get a new job, learn a new skill, understand a subject better or indeed do any of the other 101 things that a librarian does? Well, no. So in actual fact *it's not a robot librarian* then is it? Its [sic] as close to being a librarian as a shelf stacker is to managing the supermarket. In future less hyperbole and more accurate reporting please

The commenter (who is a well-known information professional) clearly has an issue with the labelling of Hugh as a 'librarian', and the inaccurate level of ability therefore assigned to him, which raises all kinds of questions about the language we use to describe such technologies, and how people will react as more and more complex tasks are able to be performed by machines rather than humans. Although there has arguably been a generally positive reaction towards AI and robots that have thus far been introduced in a library environment, we are still at the very early stages of these kinds of developments, and examples such as Xiaotu, Bob, and Hugh are arguably easy to accept because of their relatively limited capabilities, which are not yet close to removing the need for humans. The study in question will aim to explore these issues further, drawing on the existing research and real-life examples, as well as considering the implications of possible future developments.

Methodology

This project will implement a mixed methodology, with the combination of a survey in the form of an online questionnaire to gather quantitative and some qualitative data, with focus groups to gain further qualitative information. A detailed literature review will first be carried out to fully explore existing research and studies (as briefly outlined above), from which a set of questions can be formulated. The questionnaire will use previous surveys such as those by the European Commission (2012 & 2015) and the British Science Association (2015) as a framework for questions about AI and robots, with modifications made to reflect the library-focused nature of the research.

It will be important to create a pilot questionnaire (Pickard, 2013, 115), which could perhaps be tested on classmates or colleagues and then improved if necessary. There will be an aim to target users (or staff) of various types of libraries (through email and social media), with questions designed to establish what kinds of library they use and how often. A combination of multiple-choice and free-text responses will be gathered, allowing some limited qualitative (or anecdotal) evidence to be collected (Pickard, 2013, 111). As discussed by Bawden and Robinson (2012, 309) there must be an acceptance of the limitations of online surveys: '…all that can be known is those who replied to it; the number who saw it, and did not respond, cannot usually be established, nor can whether there is anything different about those who responded and those who did not.' Although it is hoped that a representative sample will be achieved, and the responses will provide useful information, the questionnaire will be followed by focus groups to collect truly qualitative information from a much smaller, and more targeted, group.

There will be two separate focus groups carried out, one made up of regular library users and one made up of current library staff. Ideally they would be users and staff of the same library for comparative (as well as practical) reasons, so this is where the scope will be limited to a particular type of library (probably an academic library e.g. City University). There will be a discussion based around the issues dealt with in the questionnaire, with the potential inclusion of video content or articles to be read and discussed during the session (for example some video footage of Bob the library robot, or a news article about Xiaotu).

Although Pickard (2013) does not recommend the use of focus groups for new or inexperienced researchers, she describes it as '…a more useful method of harvesting in-depth data from a wide range of participants than any other technique available,' and it is felt that as long as the groups in question are properly planned and carefully delivered then the results could be very valuable to the research in question. It is hoped that through the combination of the questionnaire and the focus group a good range of quantitative and qualitative data can be collected and analysed in various ways to tackle the objectives laid out.

Work plan

- **June-July:** Preliminary research/literature review. Preparation of online survey
- **August:** Delivery of online survey and analysis of results. Preparation of focus groups.
- **September:** Focus groups x 2
- **October-January:** Analysis of results and writing up

Resources

- Survey Monkey for online questionnaire
- Possible equipment needed for focus group: recording device (audio alone not always best way to record events as difficult to analyse group discussion on audio, so audio+video may be preferable); flipchart and pens; briefing sheet; disclaimer (Pickard, 2013, 245). Also a screen/projector to show video or display other media.
- Statistical software for data analysis (e.g. Excel)

Ethics

Part A: Ethics Checklist

If your answer to any of the following questions (1 – 3) is YES, you must apply to an appropriate external ethics committee for approval:		*Delete as appropriate*
1.	Does your project require approval from the National Research Ethics Service (NRES)? (E.g. because you are recruiting current NHS patients or staff? If you are unsure, please check at http://www.hra.nhs.uk/research-community/before-you-apply/determine-which-review-body-approvals-are-required/)	**No**
2.	Will you recruit any participants who fall under the auspices of the Mental Capacity Act? (Such research needs to be approved by an external ethics committee such as NRES or the Social Care Research Ethics Committee http://www.scie.org.uk/research/ethics-committee/)	**No**
3.	Will you recruit any participants who are currently under the auspices of the Criminal Justice System, for example, but not limited to, people on remand, prisoners and those on probation? (Such research needs to be authorised by the ethics approval system of the National Offender Management Service.)	**No**

If your answer to any of the following questions (4 – 11) is YES, you must apply to the Senate Research Ethics Committee for approval (unless you are applying to an external ethics committee):		*Delete as appropriate*
4.	Does your project involve participants who are unable to give informed consent, for example, but not limited to, people who may have a degree of	**No**

	learning disability or mental health problem, that means they are unable to make an informed decision on their own behalf?	
5.	Is there a risk that your project might lead to disclosures from participants concerning their involvement in illegal activities?	**No**
6.	Is there a risk that obscene and or illegal material may need to be accessed for your project (including online content and other material)?	**No**
7.	Does your project involve participants disclosing information about sensitive subjects?	**No**
8.	Does your project involve you travelling to another country outside of the UK, where the Foreign & Commonwealth Office has issued a travel warning? (http://www.fco.gov.uk/en/)	**No**
9.	Does your project involve invasive or intrusive procedures? For example, these may include, but are not limited to, electrical stimulation, heat, cold or bruising.	**No**
10.	Does your project involve animals?	**No**
11.	Does your project involve the administration of drugs, placebos or other substances to study participants?	**No**

If your answer to any of the following questions (12 – 18) is YES, you should consult your supervisor, as you may need to apply to an ethics committee for approval.		*Delete as appropriate*
12.	Does your project involve participants who are under the age of 18?	**No**
13.	Does your project involve adults who are vulnerable because of their social, psychological or medical circumstances (vulnerable adults)? This includes adults with cognitive and / or learning disabilities, adults with physical disabilities and older people.	**No**
14.	Does your project involve participants who are recruited because they are staff or students of City University London? For example, students studying on a particular course or module. (If yes, approval is also required from the Project Tutor.)	**No**
15.	Does your project involve intentional deception of participants?	**No**
16.	Does your project involve identifiable participants taking part without their informed consent?	**No**
17.	Does your project pose a risk to participants or other individuals greater than that in normal working life?	**No**

18.	Does your project pose a risk to you, the researcher, greater than that in normal working life?	**No**

If your answer to the following question (19) is YES and your answer to all questions 1 – 18 is NO, you must complete part B of this form.		
19.	Does your project involve human participants? For example, as interviewees, respondents to a questionnaire or participants in evaluation or testing.	**Yes**

Part B: Ethics Proportionate Review Form

If you answered YES to question 19 and NO to all questions 1 – 18, you may use this part of the form to submit an application for a proportionate ethics review of your project. Your dissertation project supervisor will review and approve this application.

The following questions (20 – 24) must be answered fully.		*Delete as appropriate*
20.	Will you ensure that participants taking part in your project are fully informed about the purpose of the research?	**Yes**
21.	Will you ensure that participants taking part in your project are fully informed about the procedures affecting them or affecting any information collected about them, including information about how the data will be used, to whom it will be disclosed, and how long it will be kept?	**Yes**
22.	When people agree to participate in your project, will it be made clear to them that they may withdraw (i.e. not participate) at any time without any penalty?	**Yes**
23.	Will consent be obtained from the participants in your project, if necessary? Consent from participants will only be necessary if you plan to gather personal data. "Personal data" means data relating to an identifiable living person, e.g. data you collect using questionnaires, observations, interviews, computer logs. The person might be identifiable if you record their name, username, student id, DNA, fingerprint, etc. *If YES, attach the participant information sheet(s) and consent request form(s) that you will use. You must retain these for subsequent inspection. Failure to provide the filled consent request forms will automatically result in withdrawal of any earlier ethical approval of your project.* **This will be produced at a later date.**	**Yes**
24.	Have you made arrangements to ensure that material and/or private information obtained from or about the participating individuals will remain confidential? Provide details:	**Yes**

	This will be confirmed at a later date.	

If the answer to the following question (25) is YES, you must provide details		*Delete as appropriate*
25.	Will the research involving participants be conducted in the participant's home or other non-University location? *If **YES**, provide details of how your safety will be ensured:* **Location of potential focus groups will be confirmed at a later date**	**Possibly**

Confidentiality

Online surveys – this will be anonymous, and any potentially identifying information will be correctly handled

Focus groups – will need to consider whether any results should be anonymised, or whether participants are willing to be identified/credited in the write-up.

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Reflection

The initial concept I had for this dissertation project was to look into the use of self-service machines in libraries, and how they are viewed by both library workers and users. Based on my own personal experience I had a theory that, although self-service may be beneficial in many ways, such as saving staff time and allowing users to be more dependent, there may also be detrimental effects of library users not coming into contact with library staff as often, and they may miss out on receiving important information and assistance. It was when I proposed this idea in front of classmates that the related idea of automation, robots and AI came up, with somebody mentioning that they had seen an article about 'Bob' the robot 'security guard' that had been tested at the University of Birmingham Library.

From this point I began to look into recent developments in robotics and AI, and increasingly noticed stories in the media about the idea that robots are going to 'steal our jobs', as well as finding more examples of 'library robots'. I decided that as well as considering the role of self-service as an existing example of automation in libraries, it would also be interesting to explore these broader issues so that is what was, so that is what my dissertation proposal was based on. In between submitting my proposal and carrying out the original research for the project I was given the opportunity to present at a small workshop hosted by the Institute of Historical Research Library, titled 'Emerging Research in Library & Information Science'. This was a really good chance to synthesise the findings I had made so far for my literature review and present them to other LIS students and professionals, and I gained some valuable feedback and new ideas for my research.

I chose to carry out both a survey and a focus group as I recognised that it would be useful to gain both quantitative and qualitative data, although I did not conduct multiple focus groups as had been initially proposed as I felt that this would be slightly overambitious considering my limited expertise and time-constraints. It was an extremely valuable experience for me to plan and conduct the survey and focus group as I had not carried out either of this kinds of research before, and I learned much about the benefits, as well as the limitations, of each. While I recognise that it possibly did not gain a representative sample, I really saw the benefits of social networks for distributing and sharing my online questionnaire, and was pleased with the level of engagement. Also it was gratifying to receive support from my colleagues at the IoE Library for my focus group, and I think some really interesting and important issues were discussed. If I were to carry out focus groups again in future I think I would explore the use of transcription software or services, as this was a time-consuming process, but doing it myself on this occasion certainly aided my analysis and understanding of the results.

There were some slight changes to the aims and objectives originally stated in my proposal to make them more clear and focused, as recommended by my supervisor Dr Lynne Robinson, as well as small changes to my research methods, but overall I feel that my final piece of work reflects what I originally set out to do well. Based on the literature and my own research I would make the personal prediction that increasingly advanced automation in libraries, and everywhere else, seems to be inevitable and could lead to a complete reshaping of library work. However, I also believe that this can potentially be beneficial for both library users and workers, as long as a cautious approach is taken, and the needs of both groups are considered, particularly with regard to the concept of empathy.

As discussed I have several ideas for how the research could be expanded to further prove or disprove these predictions, and I would particularly like to see more in-depth research on the existing examples of 'library robots' that are in operation. Overall, despite the inevitable stresses

caused by time pressure and suffering from ‘information overload’ at points, I found this to be an enjoyable and educational process and hope that I was able to draw out some interesting and useful points related to robots and AI, and the future of library work.